

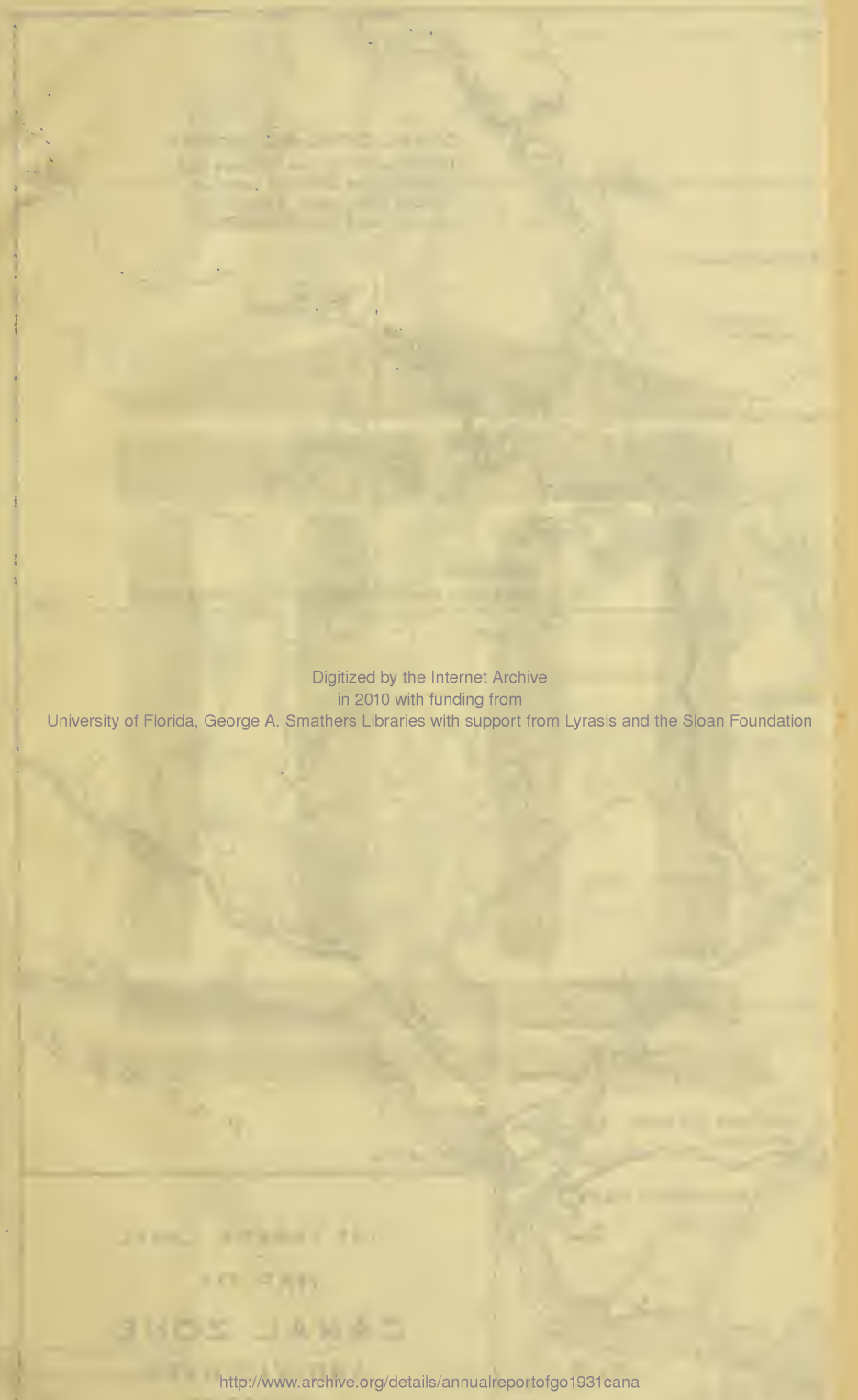
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ANNUAL REPORT OF THE
GOVERNOR OF THE
PANAMA CANAL, 1931

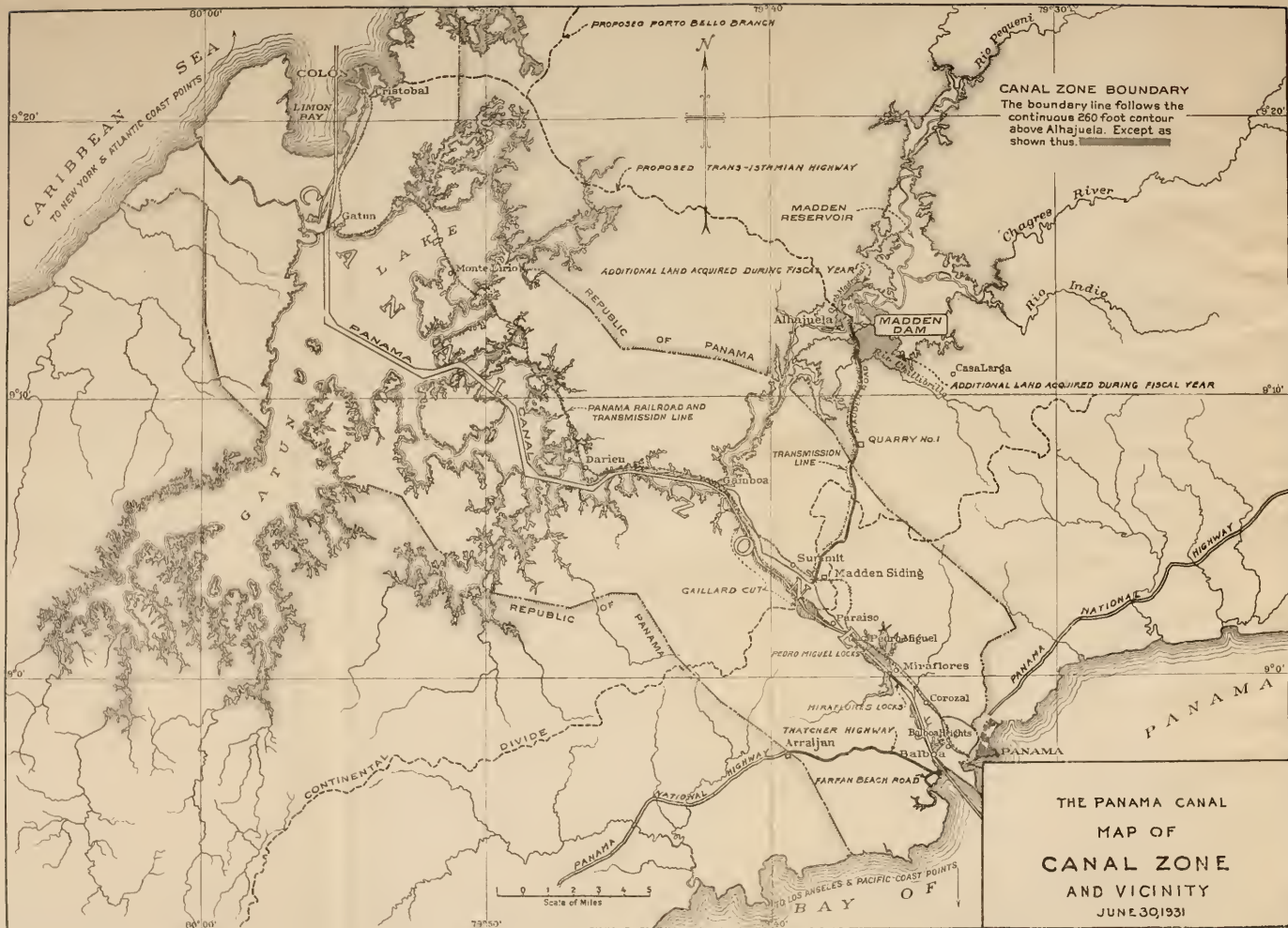
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ANNUAL REPORT
OF THE
GOVERNOR OF
THE PANAMA CANAL

FOR THE
FISCAL YEAR
ENDED JUNE 30
1931



UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1931

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REPORTS OF HEADS OF DEPARTMENTS AND DIVISIONS

APPENDIXES NOT PRINTED

The material in the annual report of the Governor of the Panama Canal, published in this volume, is to a large extent a summary of data presented in annual reports from the heads of departments and divisions in the canal organization; the latter, regarded as appendixes to the report of the governor, are not printed. The annual report of the Panama Railroad Co. is published separately. The reports of the heads of departments and divisions, as listed below, may be consulted at the Washington office of the Panama Canal or the office of the governor at Balboa Heights, Canal Zone:

Engineer of maintenance, report of—

Dredging division, report of superintendent.

Madden Dam project, report of designing engineer.

Assistant engineer of maintenance—

Electrical division, report of electrical engineer.

Municipal engineering division, report of municipal engineer.

Division of lock operation—

Atlantic locks, report of superintendent.

Pacific locks, report of superintendent.

Office engineer, report of.

Section of surveys, report of chief.

Gatun Dam and back fills, report of supervisor.

Marine division, report of superintendent.

Mechanical division, report of superintendent.

Supply department, report of chief quartermaster.

Accounting department, report of auditor.

Health department, report of chief health officer.

Executive department—

Division of civil affairs, report of chief.

Police and fire division, report of chief.

Division of schools, report of superintendent.

Bureau of clubs and playgrounds, report of general secretary.

Surveying officer, report of.

Magistrate courts—

Magistrate, Cristobal, report of.

Magistrate, Balboa, report of.

District attorney, report of.

District court, report of clerk.

Marshal, report of.

Land agent, the Panama Canal and Panama Railroad Co., report of.

Purchasing department, report of the general purchasing officer and chief of Washington office.

ANNUAL REPORT
OF THE
GOVERNOR OF THE PANAMA CANAL

BALBOA HEIGHTS, CANAL ZONE,
September 1, 1931.

The SECRETARY OF WAR,
Washington, D. C.

SIR: I have the honor to submit the report of the Governor of the Panama Canal for the fiscal year ended June 30, 1931.

Respectfully,

H. BURGESS, *Governor.*

SUMMARY

Traffic through the Panama Canal during the year ending June 30, 1931, was appreciably less than in the three fiscal years preceding, and both revenues and expenses declined. The services afforded to shipping were, however, maintained according to the established standards.

The number of transits of commercial vessels during the year was 5,529, as compared with 6,185 in 1930, a decrease of 656, or 10.6 per cent. Net tonnage of transiting vessels totaled 27,792,146 tons, Panama Canal measurement, as compared with 29,980,614 tons in 1930, a decrease of 7.3 per cent. Tolls levied during the year on commercial seagoing vessels amounted to \$24,645,456.57 as compared with \$27,076,890.01 for 1930, a decrease of \$2,431,433.44 or 9 per cent. Cargo carried through the canal during the year amounted to 25,082,800 long tons as compared with 30,030,232 tons for 1930, a decrease of 16.5 per cent.

The decrease in the number of commercial transits and the amount of cargo carried through the canal, occurred among vessels of all the major trade routes with the exception of that between Europe and the west coast of the United States and Canada; this route showed a slight increase in transits with a decrease in cargo tonnage carried.

Details are presented in Section I.

The primary function of the canal is the dispatch of vessels from ocean to ocean with the maximum safety and the minimum of delay. Throughout the year the canal force maintained its high standards of expeditious service, not only in the actual transiting of ships, but in the various supplementary services to shipping. Included in the

year's traffic but not counted with the commercial vessels were the transits of the scouting and control fleets of the United States Navy, from the Atlantic in February and returning in March. These passages occurred during the time of overhaul of Gatun Locks but were accomplished without notable accident or interference with commercial traffic.

BUSINESS OPERATIONS

Secondary only to the operation and maintenance of the canal is the function of supplying various services to ships. For doing this, and also caring for canal plant and equipment and furnishing necessary services to the personnel engaged in canal operations, the Panama Canal and the Panama Railroad Co. maintain and operate repair shops, dry docks, coaling stations, fuel oil handling plants, adequate terminal facilities for the transshipment of cargo, storehouses for the sale of ships' chandlery supplies, commissaries for the sale of foodstuffs, a railroad across the Isthmus, a steamship line plying between the United States and the Canal Zone to bring supplies and transport employees, and other essential services. All of these services, furnished by the Panama Canal and the Panama Railroad, are under coordinated centralized control, which tends to economy and efficient operation. Other important functions of administration and government are all embraced under the single organization of the Panama Canal and under the direct control of the governor—namely, public health; quarantine; immigration service; customs; post offices; schools; police and fire protection; construction and maintenance of roads, streets, and water supply systems; hydrographic and meteorological observations; steamship inspections; aids to navigation; control of commercial aircraft, etc. The work in many of these services was less in the fiscal year 1931 than in preceding years but in others, especially community services, there was no decrease. Details are presented in the several sections of the report.

NET REVENUE OF THE CANAL AND ITS AUXILIARIES

The net income from tolls and other miscellaneous receipts known as canal revenue was \$14,847,227.21. This was less than the net revenues for the fiscal year 1930 by \$3,235,224.57, or approximately 18 per cent. These revenues for the past five years have been \$15,611,093.80 in 1927, \$18,224,844.86 in 1928, \$17,729,775.01 in 1929, \$18,082,451.78 in 1930, and \$14,847,227.21 in 1931. With deduction of \$7,512,922.19 as a fixed capital charge, the canal operations showed a surplus of \$7,334,305.02 in 1931. Based on an interest-bearing capital indebtedness of \$535,571,809.48 at the end of the fiscal year 1931, the net revenue of \$14,847,227.21 in 1931 was equivalent to a return of approximately 2¾ per cent.

The net profits of auxiliary business operations conducted directly by the Panama Canal, the most important of which are the electric light and power system, mechanical shops, material storehouses, and fuel-oil plants, totaled \$562,764.17 as compared with \$760,971.66 in 1930, a decrease of \$198,207.49, or 26 per cent. These revenues have been, for the past five years, \$876,536.80 in 1927, \$736,719.43 in 1928, \$737,850.26 in 1929, \$760,971.66 in 1930, and \$562,764.17 in 1931. With deduction of a fixed capital charge of \$836,574.88 in 1931 the business operations showed a deficit of \$273,810.71.

The net profits of operations of the Panama Railroad Co., exclusive of the Panama Railroad Steamship Line, but including commissaries, docks, coaling plants, cattle industry, and cold-storage plants, were \$991,383.72 as compared with \$1,523,874.82 in 1930, a decrease of \$532,491.10, or approximately 35 per cent. These profits in the past five years have been: \$1,644,189.37 in 1927, \$1,600,283.61 in 1928, \$1,693,873.17 in 1929, \$1,523,874.82 in 1930, and \$991,383.72 in 1931.

Total net revenue for the year from all sources (Panama Canal and Panama Railroad, exclusive of the Panama Railroad Steamship Line) was \$16,401,375.10 as compared with \$20,367,297.72 for 1930, a decrease of \$3,965,922.62, or about 19 per cent. The corresponding figures for total net revenue for the past five years have been: \$18,131,819.97 in 1927, \$20,561,847.90 in 1928, \$20,161,498.44 in 1929, \$20,367,297.72 in 1930, and \$16,401,375.10 in 1931.

The aggregate net revenue from all sources was less than that for any year since 1925. This shortage is due, primarily, to decreased shipping activities for the year as compared with the preceding five years.

Considering the capital invested and accumulated interest on the investment, the present total capital liability is such that the canal is not as yet earning the annual interest charge at 4 per cent. For this reason and others, including the necessity of extensive additional expenditures in order to bring the canal to its highest efficiency, it would appear that at present there is no occasion to consider a reduction in tolls.

SERVICES RENDERED BY THE CANAL TO SHIPPING

The most important items of the business of the canal and its adjuncts, covering principal services to shipping, are expressed numerically in the following table, which presents a comparison of the

activities during the fiscal year 1931 with two years immediately preceding:

	Fiscal year 1929	Fiscal year 1930	Fiscal year 1931
Transits of the canal by ships paying tolls.....	6,413	6,185	5,529
Free transits.....	616	600	568
Total transits of ocean vessels.....	7,029	6,785	6,097
Average daily transits:			
Commercial traffic.....	17.570	16.945	15.148
Free transits.....	1.688	1.644	1.556
Total.....	19.258	18.589	16.704
Transits of launches (not counted in commercial traffic).....	167	91	113
Number of lockages during year:			
Gatun locks.....	6,289	6,135	5,571
Pedro Miguel locks.....	6,473	6,436	5,824
Miraflores locks.....	6,325	6,338	5,783
Average lockages per day:			
Gatun locks.....	17.2	16.8	15.3
Pedro Miguel locks.....	17.7	17.6	16.0
Miraflores locks.....	17.3	17.4	15.8
Tolls levied on ocean vessels.....	\$27,127,376.91	\$27,076,890.01	\$24,645,456.57
Tolls on launches (not included in above).....	1,512.39	517.77	652.32
Total tolls.....	27,128,889.30	27,077,407.78	24,646,108.89
Cargo passing through canal (tons).....	30,663,006	30,030,232	25,082,800
Net tonnage (Panama Canal measurement) of transiting vessels.....	29,837,794	29,980,614	27,792,146
Cargo per net ton of ocean vessels, including those in ballast.....	1.0276	1.0017	.9025
Average tolls per ton of cargo, including vessels in ballast.....	\$0.88469	\$0.90165	\$0.98256
Calls at canal ports by ships not transiting canal.....	1,089	1,136	983
Cargo handled and transferred at ports (tons).....	1,559,311	1,347,264	1,168,268
Coal, sales and issues (tons).....	305,434	282,569	169,504
Coal, number of ships served other than vessels operated by the Panama Canal.....	935	760	452
Fuel oil pumped (barrels).....	12,951,710	13,593,907	12,120,522
Fuel oil, number of ships served other than vessels operated by the Panama Canal.....	2,358	2,431	2,044
Ships repaired, other than Panama Canal equipment.....	1,087	960	770
Ships dry-docked, other than Panama Canal equipment.....	156	148	135
Provisions sold to ships (commissary sales).....	\$1,703,986.72	\$1,570,485.07	\$1,293,384.67
Chandlery sold to ships (storehouse sales).....	144,937.36	78,911.16	55,309.48

SECTION I
CANAL OPERATION AND TRADE VIA PANAMA
TRAFFIC IN 1931

Commercial traffic through the Panama Canal during the fiscal year ended June 30, 1931, was less than in any of the three preceding fiscal years 1928, 1929, and 1930. This is true with respect to all of the four features usually considered—number of transits, net tonnage, tolls, and tonnage of cargo. With respect to cargo tonnage, that through the canal in the fiscal year 1931 was also less than in the fiscal years 1926 and 1927; that is, it was exceeded in each of the five years preceding.

The fiscal years 1928 and 1929 represent peak years so far in the history of the canal. In 1930 there was a decrease, relatively slight, but in the year ended June 30, 1931, it was much more pronounced.

The number of transits of commercial vessels through the canal in 1931 was 5,529, as compared with 6,185 in the preceding year. This was a decrease of 656, or 10.6 per cent. The average daily number of transits in 1931 was 15.15, in comparison with 16.95 in 1930. Transits of naval vessels and other public vessels of the United States, public vessels of the Republics of Panama and Colombia, and those transiting solely for repairs, none of which paid tolls, numbered 568 during 1931, as compared with 600 for 1930. Combining the two, there were 6,097 transits of seagoing vessels during 1931, as compared with 6,785 in 1930, or daily averages of 16.70 and 18.59, respectively.

The net tonnage, Panama Canal measurement, of the 5,529 commercial vessels transiting in 1931, was 27,792,146, a decrease of 7.3 per cent under 1930.

Tolls levied during the fiscal year 1931 amounted to \$24,645,456.57, and were 9 per cent less than in the fiscal year 1930.

Cargo carried through the canal aggregated 25,082,800 long tons in 1931, a decrease of 16.5 per cent under that of the fiscal year 1930.

Cargo declined more heavily in comparison with the preceding year than any other feature. The principal factor in this heavy decline was a large decrease in the Atlantic-to-Pacific movement, which is made up principally of various manufactured goods coming from the United States and Europe. The decrease of cargo tonnage in this direction was 2,795,296 tons, or 29.5 per cent, in comparison with the previous fiscal year. The cargo movement in the opposite direction, made up largely of raw materials, showed a smaller decrease in comparison with 1930—2,152,136 tons, or 10.5 per cent. Cargo movement declined on all of the major trade routes.

The decreases in numbers of transits of commercial vessels in the fiscal year 1931, as compared with the preceding year, occurred

among vessels on all of the major trade routes with the exception of that between Europe and the west coast of the United States and Canada; on this there was an increase of 46, or 4.5 per cent, in transits, although there was a decrease of 27.7 per cent in the cargo tonnage on this route. There was little change in the trade between Europe and Australasia, the figures showing one more transit in 1931 than in 1930. In the important United States intercoastal trade there occurred a decrease of 331 transits (16.3 per cent). The decline in tanker traffic contributed largely to this decrease, this class of traffic accounting for 156 fewer transits than in the previous year. The trade between the east coast of the United States and west coast of South America declined 181 transits, or 26.3 per cent, in comparison with the previous fiscal year; the slump on this route, which is third in importance of those using the canal, was due largely to lessened shipments of iron ore and nitrate and to the suspension of an important passenger and cargo line between Chilean ports and New York. The trade between the United States and the Far East decreased 28 transits, or 6.4 per cent; that between Europe and the west coast of South America declined 88 transits, or 16.2 per cent; and that between the United States and Australasia 49 transits, or 37.4 per cent.

The receipts from tolls reported by the accounting department for the fiscal year 1931 were \$24,644,550.39. This figure includes tolls on launches, which are not included in "commercial traffic" of ocean-going ships, and has been adjusted in accordance with refunds for overcharges and supplemental collections in the event of undercharges. Those items account for the difference of \$906.18 between the accounting figure and the figure for tolls levied on commercial traffic as reported in the following studies of traffic, which are based on tolls levied at time of transit.

Commercial traffic figures for each fiscal year since the canal was opened to navigation are shown in the table below.

Fiscal year ended June 30	Number of transits	Panama Canal net tonnage	Tolls	Tons of cargo
1915 ¹	1,075	3,792,572	\$4,367,550.19	4,888,454
1916 ²	758	2,396,162	2,408,089.62	3,094,114
1917.....	1,803	5,798,557	5,627,463.05	7,058,563
1918.....	2,069	6,574,073	6,438,553.15	7,532,031
1919.....	2,024	6,124,990	6,172,828.59	6,916,621
1920.....	2,478	8,546,044	8,513,933.15	9,374,499
1921.....	2,892	11,415,876	11,276,889.91	11,599,214
1922.....	2,736	11,417,459	11,197,832.41	10,884,910
1923.....	3,967	18,605,786	17,508,414.85	19,567,875
1924.....	5,230	26,148,878	24,290,963.54	26,994,710
1925.....	4,673	22,855,151	21,400,523.51	23,958,836
1926.....	5,197	24,774,591	22,931,055.98	26,037,448
1927.....	5,475	26,227,815	24,228,830.11	27,748,215
1928.....	6,456	29,458,634	26,944,499.77	29,630,709
1929.....	6,413	29,837,794	27,127,376.91	30,663,006
1930.....	6,185	29,980,614	27,076,890.01	30,030,232
1931.....	5,529	27,792,146	24,645,456.57	25,082,800
Total.....	64,960	291,747,142	272,157,451.32	301,062,237

¹ Canal opened to traffic Aug. 15, 1914.

² Canal closed to traffic approximately 7 months of fiscal year by slides

During the fiscal year 1931 the variations in numbers of transits from month to month were slightly greater than in preceding years. The range was from the minimum of 400 in June to 517 in October, a difference of 117 vessels, or 29.25 per cent of the lower number. In 1930 the variation was 86, in 1929 it was 116, and in 1928 it was 108. In 1931 the daily average number of transits ranged between 16.68 in October, and 13.33 in June, a difference of 3.35. The monthly average of transits was 461, in comparison with 515 for the previous year. Monthly transits and tolls, with daily averages, for commercial vessels only, were:

Month	Total for month		Daily averages	
	Transits	Tolls	Transits	Tolls
1930				
July.....	488	\$2, 180, 511. 82	15. 74	\$70, 339. 09
August.....	465	2, 080, 230. 42	15. 00	67, 104. 21
September.....	458	2, 057, 103. 58	15. 27	68, 570. 12
October.....	517	2, 288, 982. 08	16. 68	73, 888. 13
November.....	479	2, 098, 357. 36	15. 97	69, 945. 25
December.....	495	2, 192, 683. 85	15. 97	70, 728. 51
1931				
January.....	476	2, 108, 140. 42	15. 35	68, 004. 53
February.....	431	1, 915, 902. 78	13. 39	68, 425. 10
March.....	439	1, 964, 434. 22	14. 16	63, 368. 85
April.....	453	2, 014, 349. 13	15. 10	67, 144. 97
May.....	428	1, 923, 452. 18	13. 81	62, 046. 84
June.....	400	1, 821, 408. 73	13. 33	60, 713. 62
Total.....	5, 529	24, 645, 456. 57	15. 15	67, 521. 80

Comparison by months with traffic in the preceding fiscal year is shown as follows:

Month	Number of vessels		Panama Canal net tonnage		Tons of cargo		Tolls	
	1929-30	1930-31	1929-30	1930-31	1929-30	1930-31	1929-30	1930-31
July.....	527	488	2, 468, 280	2, 438, 895	2, 598, 162	2, 402, 047	\$2, 259, 582. 37	\$2, 180, 511. 82
August.....	541	465	2, 558, 739	2, 345, 573	2, 680, 730	2, 148, 469	2, 327, 437. 86	2, 080, 230. 42
September.....	523	458	2, 425, 261	2, 314, 424	2, 432, 783	2, 059, 582	2, 261, 789. 40	2, 057, 103. 58
October.....	564	517	2, 747, 949	2, 584, 160	2, 845, 643	2, 394, 410	2, 485, 897. 71	2, 288, 982. 08
November.....	525	479	2, 498, 906	2, 371, 487	2, 534, 631	2, 265, 200	2, 244, 895. 94	2, 098, 357. 36
December.....	522	495	2, 548, 771	2, 473, 626	2, 524, 934	2, 166, 884	2, 309, 030. 88	2, 192, 583. 85
January.....	531	476	2, 601, 628	2, 380, 871	2, 611, 632	2, 109, 937	2, 360, 211. 24	2, 108, 140. 42
February.....	491	431	2, 369, 255	2, 134, 866	2, 377, 900	1, 930, 219	2, 131, 386. 12	1, 915, 902. 78
March.....	515	439	2, 505, 859	2, 211, 934	2, 558, 238	1, 915, 507	2, 260, 002. 36	1, 964, 434. 22
April.....	489	453	2, 479, 096	2, 292, 805	2, 456, 782	2, 011, 117	2, 232, 763. 00	2, 014, 349. 13
May.....	479	428	2, 418, 633	2, 184, 959	2, 261, 616	1, 925, 452	2, 162, 898. 60	1, 923, 452. 18
June.....	478	400	2, 358, 237	2, 058, 546	2, 147, 181	1, 758, 976	2, 100, 994. 53	1, 821, 408. 73
Total....	6, 185	5, 529	29, 980, 614	27, 792, 146	30, 030, 232	25, 082, 800	27, 076, 890. 01	24, 645, 456. 57

PROPORTION OF TANKER TRAFFIC

Transits of tank ships during the fiscal year 1931 totaled 944, a decrease of 274 or 22.5 per cent below the 1,218 of the preceding year. The 1931 transits of tankers were the lowest for any fiscal year since

the beginning of the heavy movement of mineral oils from the California field in the fiscal year 1923. Tanker traffic in 1931 comprised 17.1 per cent of the total commercial transits during the year; made up 19 per cent of the total net tonnage (Panama Canal measurement) paid 19 per cent of the tolls collected; and carried 20.3 per cent of the cargo which passed through the canal.

Transits of ships engaged in general traffic (all commercial shipping exclusive of tanker traffic) was 382, or 7.7 per cent, fewer than the number transiting in 1930. With respect to net tonnage (Panama Canal measurement) tank ships decreased 1,279,265 tons, or 19.5 per cent, while general shipping decreased 909,204 tons, or 3.9 per cent, a net decrease on all traffic of 2,188,468 tons, or 7.3 per cent. Tolls collected from tank ships decreased \$1,086,643.14, or 18.8 per cent, while tolls collected from general cargo carriers decreased \$1,344,790.30, or 6.3 per cent, a net decrease on all classes of traffic of \$2,431,433.44, or 9 per cent.

Omitting transits of public vessels of the United States and other vessels exempt from the payment of tolls, the number of ocean-going vessels transiting the canal averaged 15.2 throughout the year. Of this number tank ships averaged 2.6 transits daily, the balance of 12.6 being made up of general cargo carriers, passenger ships, warships of foreign nations, etc.

In the tables below the commercial traffic has been segregated to show the proportion of tanker transits, tonnage, and tolls as compared with the corresponding figures embracing all other classes of traffic. The figures are for the fiscal years 1923 to 1931, inclusive, covering the era during which tanker traffic has been a very large part of the total movement.

Proportion of tank ships to total traffic

Fiscal year	Total commercial transits			Average daily transits		
	Tankers	General	Total	Tankers	General	Total
1923.....	913	3,054	3,967	2.5	8.4	10.9
1924.....	1,704	3,526	5,230	4.7	9.6	14.3
1925.....	1,079	3,594	4,673	3.0	9.8	12.8
1926.....	1,090	4,107	5,197	3.0	11.2	14.2
1927.....	1,324	4,151	5,475	3.6	11.4	15.0
1928.....	1,121	5,335	6,456	3.0	14.6	17.6
1929.....	1,083	5,330	6,413	3.0	14.6	17.6
1930.....	1,218	4,967	6,185	3.3	13.6	16.9
1931:						
July.....	120	368	488	3.9	11.8	15.7
August.....	95	370	465	3.1	11.9	15.0
September.....	94	364	458	3.1	12.1	15.2
October.....	93	424	517	3.0	13.7	16.7
November.....	83	396	479	2.8	13.2	16.0
December.....	77	418	495	2.5	13.5	16.0
January.....	78	398	476	2.5	12.8	15.3
February.....	60	371	431	2.1	13.3	15.4
March.....	65	374	439	2.1	12.1	14.2
April.....	69	384	453	2.3	12.8	15.1
May.....	61	367	428	2.0	11.8	13.8
June.....	49	351	400	1.6	11.7	13.3
Total, 1931.....	944	4,585	5,529	2.6	12.6	15.2

Proportion of tanker tonnage to total tonnage

Fiscal year	Panama Canal net tonnage			Percentage of total net tonnage		
	Tankers	General	Total	Tankers	General	Total
1923	5,374,384	13,231,402	18,605,786	28.9	71.1	100.0
1924	10,212,047	15,936,831	26,148,878	39.1	60.9	100.0
1925	6,424,622	16,430,529	22,855,151	28.1	71.9	100.0
1926	6,343,240	18,431,351	24,774,591	25.5	74.5	100.0
1927	7,624,112	18,603,703	26,227,815	29.1	70.9	100.0
1928	6,243,969	23,214,665	29,458,634	21.2	78.8	100.0
1929	5,844,263	23,993,531	29,837,794	19.6	80.4	100.0
1930	6,564,138	23,416,476	29,980,614	21.9	78.1	100.0
1931	5,284,873	22,507,273	27,792,146	19.0	81.0	100.0

Proportion of tolls from tank ships to tolls from all vessels

Fiscal year	Tolls paid by shipping using canal			Percentage of total tolls		
	Tankers	General	Total	Tankers	General	Total
1923	\$4,769,324.63	\$12,738,874.94	\$17,508,199.57	27.2	72.8	100.0
1924	9,071,835.65	15,219,127.89	24,290,963.54	37.3	62.7	100.0
1925	5,728,302.26	15,672,221.25	21,400,523.51	26.8	73.2	100.0
1926	5,626,167.93	17,304,888.05	22,931,055.98	24.4	75.6	100.0
1927	6,658,805.90	17,570,023.21	24,228,830.11	27.5	72.5	100.0
1928	5,436,437.16	21,508,062.61	26,944,499.77	20.1	79.9	100.0
1929	5,145,632.19	21,981,744.72	27,127,376.91	18.9	81.1	100.0
1930	5,768,963.28	21,307,926.73	27,076,890.01	21.3	78.7	100.0
1931	4,682,320.14	19,963,136.43	24,645,456.57	19.0	81.0	100.0

TANKER CARGOES

Cargo carried through the canal in tank ships during the fiscal year 1931 amounted to 5,102,836 tons, in comparison with 6,071,378 tons in 1930, registering a decrease of 968,542 tons, or 16 per cent. Of the 5,102,836 tons passing through in 1931, 218,723 tons were from the Atlantic to the Pacific and 4,884,113 tons from the Pacific to the Atlantic. The 218,723 tons from the Atlantic to the Pacific included 31,542 tons of creosote from Europe and Canada with destinations reported as the United States and Canada, and 187,181 tons of mineral oils from the United States, Mexico, and West Indies, destined to the United States, Far East, South America, and the Pacific terminus of the Panama Canal.

The 4,884,113 tons from the Pacific to the Atlantic included 45,911 tons of coconut oil and 12,652 tons of molasses from the Philippine Islands to the United States; 30,815 tons of molasses from the Hawaiian Islands to the United States; 12,600 tons of molasses from the Hawaiian Islands to Europe; and 19,000 tons of whale oil from Australasia to the United States. Mineral oils from the Pacific aggregated 4,763,135 tons, of which approximately 81 per cent originated in California and 19 per cent in Peru and Ecuador; they were destined as follows: 63.6 per cent to the United States; 24.1 per cent to Europe; 7.7 per cent to Canada; and the balance, 4.6 per cent

to the West Indies, South America, and the Atlantic terminus of the Panama Canal.

Of the mineral-oil tonnage carried in tankers through the canal during the fiscal year 1931, approximately 70 per cent was gasoline, benzene, and naphtha; 15 per cent crude oil; 13 per cent gas and fuel oils; and the remainder lubricating oils or kerosene.

NATIONALITY OF VESSELS

Nineteen nationalities were represented in the commercial traffic passing through the canal during the fiscal year 1931, which was five fewer than the number passing through in the previous year. Vessels of United States registry led in the number of transits, as has been the case during the preceding 12 years. From 1915 to 1918, inclusive, transits of British vessels exceeded those of any other country. In all years the greatest numbers have been either British or United States.

In the fiscal year 1931 there were 468 fewer transits, or a decline of 16.2 per cent, of vessels of United States registry in comparison with 1930, and British shipping accounted for 146 fewer transits (a decline of 9.5 per cent) in comparison with the previous year. Transits of vessels of Danish and Japanese registry made increases of 29 transits (31.9 per cent) and 30 transits (18.4 per cent), respectively. The five other leading nationalities (i. e., those contributing to more than 500,000 net tons of shipping during the year) decreased as follows: Norwegian, 8 transits (2.2 per cent); German, 8 transits (2.1 per cent); Swedish, 14 transits (11.2 per cent); French, 14 transits (11.3 per cent); and Dutch, 16 transits (11.3 per cent).

With respect to cargo carried through the canal, vessels of United States registry carried 47.1 per cent; British vessels, 23.8 per cent; Norwegian vessels, 6.9 per cent; German vessels, 5.0 per cent; Japanese vessels, 4.4 per cent; Swedish vessels, 2.9 per cent; Danish vessels, 2.4 per cent; French vessels, 2.0 per cent; and Dutch vessels, 1.9 per cent. Combined, the vessels of these nine nations carried 24,176,896 tons, or over 96 per cent of all cargo that passed through the canal during the fiscal year.

Cargo carried in the vessels of all the leading nationalities was lower than in 1930, with the exception of those flying the Danish and Japanese flags, which showed increases of 19.8 per cent and 9.4 per cent, respectively. Vessels of Dutch registry showed the largest proportionate decrease in cargo carried—22.8 per cent under the preceding year. Cargo carried in British vessels decreased 21.2 per cent; in United States vessels, 18.6 per cent; in Swedish vessels, 13.3 per cent; in French vessels, 11.9 per cent; in German vessels, 9.1 per cent; and in Norwegian vessels, 4.9 per cent.

Cargo tonnage carried under the principal flags contributing to canal traffic during the past five years is shown in the following tabulation:

Tons of cargo carried

	1927	1928	1929	1930	1931
United States.....	15,242,156	14,248,735	14,075,731	14,499,233	11,805,132
British.....	6,436,785	8,075,022	8,331,221	7,572,969	5,971,281
Norwegian.....	1,052,453	1,268,124	1,505,366	1,808,278	1,720,383
German.....	973,741	1,185,421	1,482,279	1,388,022	1,261,763
Japanese.....	1,036,786	1,041,166	980,041	1,009,735	1,104,512
Swedish.....	652,173	705,154	845,664	832,273	721,945
Danish.....	261,543	380,240	518,452	505,914	606,100
French.....	530,026	600,421	530,763	576,753	508,011
Dutch.....	571,700	637,178	695,956	618,718	477,769
All remaining.....	990,852	1,489,248	1,697,533	1,218,337	905,904
Total.....	27,748,215	29,630,709	30,663,006	30,030,232	25,082,800

Segregation of the traffic through the canal during the fiscal year 1931, by nationality, is presented in the following table, showing transits, measurement tonnage, tolls, and tons of cargo:

Commercial traffic through the Panama Canal, by nationality of vessels

Nationality	Number of ships	Measurement tonnage				Tolls	Tons of cargo
		Panama Canal net	United States equivalent	Registered gross	Registered net		
Belgian.....	24	124,377	98,074	152,535	95,997	\$116,452.51	156,411
British.....	1,390	7,518,171	5,494,150	9,112,341	5,558,611	6,580,987.70	5,971,281
Chilean.....	42	170,928	122,226	244,552	136,747	166,732.50	99,234
Colombian.....	104	15,526	15,030	23,562	15,036	17,840.61	17,847
Danish.....	120	611,380	434,337	697,487	439,570	519,535.67	606,100
Danzig.....	27	184,928	153,853	260,698	147,527	165,459.25	185,982
Dutch.....	125	578,680	383,469	643,802	385,968	473,269.39	477,769
French.....	110	609,915	432,486	736,590	437,281	523,263.93	508,011
German.....	369	1,412,256	979,905	1,657,275	986,522	1,204,084.62	1,261,763
Greek.....	8	30,965	21,578	34,598	21,457	26,342.87	45,273
Italian.....	67	468,239	330,590	603,987	360,287	404,674.43	236,570
Japanese.....	193	1,019,832	856,815	1,294,940	841,343	1,052,413.33	1,104,512
Norwegian.....	363	1,748,728	1,203,067	2,002,601	1,204,848	1,403,922.86	1,720,383
Panamanian.....	36	82,841	50,180	86,913	50,884	60,204.86	55,422
Peruvian.....	2	7,088	7,020	10,124	5,788	8,565.60	7,328
Spanish.....	9	22,650	18,149	28,515	17,500	22,053.99	27,030
Swedish.....	111	528,282	372,389	562,881	454,798	424,924.05	721,945
United States.....	2,417	12,601,828	9,580,909	15,613,163	9,567,459	11,425,999.31	11,805,132
Yugoslav.....	12	55,532	40,962	66,260	40,838	48,679.09	74,807
Total, 1931.....	5,529	27,792,146	20,595,189	34,232,824	20,768,461	24,645,456.57	25,082,800
Total, 1930.....	6,185	29,980,614	22,683,006	37,430,657	22,797,619	27,076,890.01	30,030,232
Total, 1929.....	6,413	29,837,794	22,793,847	37,464,792	22,900,317	27,127,376.91	30,663,006

NET TONNAGE OF VESSELS

Included in the 5,529 commercial vessels transiting the canal during the fiscal year ended June 30, 1931, were 10 naval vessels paying tolls on the basis of displacement tonnage, and 5,519, merchant vessels, yachts, etc., paying on the basis of net tonnage. Fifty-three and three-tenths per cent of the 5,519 commercial transits on which tolls were levied on net tonnage were by vessels of from 4,000 to

6,000 net tons, Panama Canal measurement. Five and five-tenths per cent were by vessels under 1,000 net tons, and 1.9 per cent by vessels over 10,000 net tons. The average tonnage of all transits was 5,036 net tons as compared with 4,862 net tons for the preceding fiscal year, an increase of 174 tons, or 3.6 per cent.

Vessels of Italian registry averaged the highest net tonnage, 6,989, with those of Danzig registry second with 6,849 net tons, and those of French registry third with 5,545 net tons. The lowest recorded average by nationality was for Colombia with 149 net tons, the next lowest for Panamanian vessels with 2,301 net tons, and the next lowest for Spanish vessels with 2,831 net tons.

The German liner *Columbus*, of 20,079 net tons, Panama Canal measurement, was the largest commercial vessel transiting during the year.

VESSELS ENTITLED TO FREE TRANSIT AND LAUNCHES OF LESS THAN 20 TONS NET MEASUREMENT

Naval and other vessels owned and operated in the Government service of the United States, Panama, and Colombia, and vessels transiting the canal solely for repairs at the Balboa shops, are exempt from the payment of tolls, and such vessels are not included in the transit statistics in the preceding sections. They accounted for the following additional transits in the fiscal year 1931: Public vessels of the United States, 544; public vessels of the Republic of Panama, 7; vessels transiting for repairs, 17; a total of 568. These vessels carried a total of 131,775 tons of cargo.

If charges at commercial rates had been made against the 544 public vessels of the United States that transited the canal without the payment of tolls, the revenue from tolls would have been increased by approximately \$1,157,853.20 during the year. Tolls on the 7 Panamanian Government vessels and the 17 ships transiting for repairs would have amounted to approximately \$23,251.29.

Launches of less than 20 tons measurement (Panama Canal net) are also excluded from the statistics of commercial traffic, although they are not exempt from the payment of tolls. The number of these transiting the canal during the year was 113, and tolls aggregating \$652.32 were collected for their passage.

TRADE ROUTES AND CARGO

As in previous fiscal years, the preponderant movements of cargo were to or from the two coasts of North America. In the traffic from Atlantic to Pacific approximately 74 per cent of the cargo originated on the east coast of North America, and about 54 per cent of all cargo going through to the Pacific was destined to the west coast of North

America. Of the traffic in the opposite direction, 66 per cent of the total came from the west coast of North America and about 60 per cent was destined to the east coast of that continent.

The specific trade routes over which moved the greater part of the cargo shipped through the canal during the fiscal year 1931 were, in order of quantity of cargo: Between the Atlantic and Pacific coasts of the United States (intercoastal); between Europe and the west coast of United States and Canada; between the east coast of the United States and the west coast of South America; between Europe and the west coast of South America; between the east coast of the United States and the Far East; between Europe and Australasia; between the east coast of the United States and Australasia; and between the east coast of the United States and the west coast of Canada. In the past year the cargo moving over these routes through the canal aggregated 22,636,044 tons, and was 90.2 per cent of the total cargo.

The following tabulation shows the aggregate movement of cargo over these eight principal routes of trade, the sum of miscellaneous routings, and the total during the past four years:

Cargo shipments through the Panama Canal during the past four fiscal years segregated by principal trade routes

Trade route	Tons of cargo			
	1928	1929	1930	1931
United States intercoastal:				
Atlantic to Pacific.....	2,576,399	3,184,141	3,161,530	2,379,751
Pacific to Atlantic.....	7,657,300	6,992,632	7,328,634	6,425,624
Total.....	10,233,699	10,176,773	10,490,064	8,805,375
Europe and west coast of United States and Canada:				
Atlantic to Pacific.....	725,304	797,856	838,226	549,948
Pacific to Atlantic.....	5,113,788	5,172,286	4,710,214	4,631,157
Total.....	5,839,092	5,970,142	5,548,440	5,181,105
East coast United States and west coast of South America:				
Atlantic to Pacific.....	356,929	404,928	378,101	252,363
Pacific to Atlantic.....	2,822,886	2,994,043	3,144,475	2,105,298
Total.....	3,179,815	3,398,971	3,522,576	2,357,661
Europe and west coast of South America:				
Atlantic to Pacific.....	761,567	845,750	881,666	503,566
Pacific to Atlantic.....	2,128,737	2,382,935	1,934,744	1,804,191
Total.....	2,890,304	3,228,685	2,816,410	2,307,757
United States and Far East, including Philippine Islands:				
Atlantic to Pacific.....	1,613,598	1,913,663	2,072,511	1,340,772
Pacific to Atlantic.....	495,350	638,618	818,184	82,053
Total.....	2,109,248	2,552,281	2,890,695	2,222,825
Europe and Australasia:				
Atlantic to Pacific.....	549,959	583,977	604,265	441,470
Pacific to Atlantic.....	552,563	573,212	594,930	671,843
Total.....	1,102,522	1,157,189	1,199,195	1,113,313

Cargo shipments through the Panama Canal during the past four fiscal years segregated by principal trade routes—Continued

Trade route	Tons of cargo			
	1928	1929	1930	1931
United States and Australasia:				
Atlantic to Pacific.....	637, 703	641, 2 ⁹	422, 839	202, 311
Pacific to Atlantic.....	106, 678	164, 745	238, 803	156, 648
Total.....	744, 381	806, 015	661, 642	368, 959
East coast United States and west coast of Canada:				
Atlantic to Pacific.....	44, 420	38, 220	32, 132	32, 345
Pacific to Atlantic.....	481, 689	377, 881	353, 717	246, 704
Total.....	526, 109	416, 101	385, 849	279, 049
Miscellaneous routes and sailings:				
Atlantic to Pacific.....	1, 043, 955	1, 472, 706	1, 084, 455	957, 903
Pacific to Atlantic.....	1, 911, 584	1, 454, 133	1, 430, 906	1, 488, 853
Total.....	3, 005, 539	2, 956, 839	2, 515, 361	2, 446, 756
Total traffic, all routes:				
Atlantic to Pacific.....	8 310, 134	9 882, 520	9 475, 725	6 680, 429
Pacific to Atlantic.....	21, 320, 575	20, 780, 486	20, 554, 507	18, 402, 371
Total.....	29, 630, 709	30, 663, 006	30, 030, 232	25, 082, 800

As will be perceived from the foregoing, the cargo over all the principal trades decreased in comparison with the previous fiscal year, although there occurred a gain in the Pacific to Atlantic movement from the Far East to the United States and from Australasia to Europe. In aggregate there was a decrease of 2,795,296 tons, or 29.5 per cent, in the Atlantic to Pacific movement; a decrease of 2,152,136 tons, or 10.5 per cent, in the Pacific to Atlantic movement; making a decrease of 4,947,432 tons, or 16.5 per cent, in the combined movement. In the Atlantic to Pacific movement the decreases were as follows: In the United States intercoastal trade, 781,779 tons, or 24.7 per cent; in the trade between Europe and United States and Canada, 288,278 tons, or 34.4 per cent; between the east coast of United States and west coast of South America, 125,738 tons, or 33.3 per cent; between Europe and the west coast of South America, 378,100 tons, or 42.9 per cent; between the United States and the Far East, 711,739 tons, or 34.3 per cent; between Europe and Australasia, 162,795 tons, or 26.9 per cent; and between the United States and Australasia, 220,528 tons, or 52.2 per cent. A slight increase occurred in the trade between the east coast of the United States and the west coast of Canada.

As stated above, increases occurred in the Pacific to Atlantic movement over two trades—from the Far East to the United States, which increased 43,869 tons, or 5.4 per cent; and from Australasia to Europe, which registered a gain of 76,913 tons, or 12.9 per cent. Increases in the shipments of sugar, silk, and general oriental goods were responsible in the case of the former, while heavier shipments

of food products in cold storage and wool contributed principally to the gain from Australasia to Europe. In the Pacific to Atlantic movement of the United States intercoastal trade there occurred a decrease of 902,910 tons, or 12.3 per cent, in comparison with the previous fiscal year, occasioned, primarily, by reduced shipments of two important commodities—mineral oils and lumber. In the trade between United States and Canada and Europe a slight decline of 79,057 tons, or 1.7 per cent, occurred. In this trade gains were made in the movement of several important food commodities such as wheat, canned goods, and fresh and dried fruits, but a heavy curtailment in the movement of mineral oils and lumber absorbed the increases. The cargo movement from the west coast of South America to the east coast of the United States had the heaviest relative decline of any trade in the Pacific to Atlantic movement during the year. The decrease amounted to 1,039,177 tons, or 33 per cent, in comparison with the previous year. Lessened iron ore and nitrate shipments were the principal factors in this decline.

From the west coast of South America to Europe there was a decrease of 130,553 tons, or 6.7 per cent, due principally to reduced nitrate shipments. In the Pacific to Atlantic movement of the trade between Australasia and the east coast of the United States, a decrease of 72,158 tons, or 30.2 per cent, occurred. This decrease was brought about principally by smaller shipments of copra, hardwoods, hemp, iron ore, and skins and hides. From the west coast of Canada to the east coast of the United States there was a decrease of 107,013 tons, or 30.3 per cent, due to smaller lumber shipments.

PRINCIPAL COMMODITIES

Statistics of commodities passing through the canal are not precise because it is not required that complete manifests of cargo carried by vessels be submitted at the canal. In lieu of a manifest the master of each vessel is required to file a "cargo declaration," which is a briefly itemized statement, listing the principal items of cargo carried, and showing their ports or country of origin and destination. These cargo declarations are the basis of the commodity statistics. There is a natural tendency not to list small miscellaneous shipments but to include them under the head of "General cargo"; not infrequently no other classification is made of entire cargoes carried by vessels. Hence, except in the case of commodities commonly shipped in bulk, such as mineral oils carried in tank ships, wheat, lumber, nitrates, etc., shipments of various goods are likely to be in excess of the aggregate tonnage reported during the year and shown in the annual summary. Subject to errors arising from this source the tonnage of the

principal commodities shipped through the canal during the past four years is shown in the following table:

Commodity movement
ATLANTIC TO PACIFIC

Commodity	Fiscal year ended June 30—			
	1928	1929	1930	1931
	<i>Long tons</i>	<i>Long tons</i>	<i>Long tons</i>	<i>Long tons</i>
Manufactures of iron and steel.....	1,855,532	2,349,566	2,128,712	1,320,091
Mineral oils.....	717,080	806,744	682,742	485,520
Phosphates.....	198,826	281,168	435,994	312,925
Cotton.....	259,225	331,652	248,345	298,877
Tin plate.....	143,610	261,899	294,382	224,291
Cement.....	280,032	379,968	412,347	206,483
Paper.....	183,263	224,276	259,314	202,478
Sulphur.....	207,257	238,231	215,831	190,690
Machinery.....	215,334	188,442	180,805	139,928
Coal and coke.....	252,740	227,883	224,439	122,179
Tobacco.....	78,943	129,433	118,322	116,946
Automobiles (exclusive of accessories).....	124,553	250,688	203,089	104,002
Canned goods (fish, fruit, vegetables, etc.).....	87,136	121,472	120,373	100,311
Textiles.....	124,658	137,886	120,750	94,254
Sugar.....	44,951	150,402	101,150	87,436
Coffee.....	69,135	55,002	60,103	79,382
Ammonia.....	91,776	108,862	153,437	79,100
Railroad material.....	188,561	239,074	194,578	77,838
Asphalt.....	82,350	93,806	97,712	72,388
Slag.....	84,797	96,894	66,945	71,627
Chemicals.....	52,493	77,286	82,417	66,690
Salt.....	35,374	59,643	54,327	56,002
Automobile accessories.....	49,052	90,577	84,213	51,768
Glass and glassware.....	61,434	73,757	68,062	47,100
Scrap metal.....	48,168	83,829	196,676	46,904
Rosin.....	36,456	45,129	39,693	39,886
Iron (metal).....	40,109	92,992	76,703	35,896
Lumber.....	33,402	50,448	48,819	32,924
Creosote.....	55,682	56,636	64,844	31,662
Agricultural implements.....	60,895	57,195	51,517	28,289
Flour.....	24,010	79,351	49,614	25,122
Bananas.....	44,616	55,979	29,502	14,903
All other.....	2,478,684	2,386,350	2,309,968	1,816,537
Total.....	8,310,134	9,882,520	9,475,725	6,680,429

PACIFIC TO ATLANTIC

Mineral oils.....	5,619,076	5,197,813	5,700,587	4,824,338
Lumber.....	3,673,832	3,311,875	3,530,879	2,747,485
Wheat.....	3,035,884	2,365,555	1,503,035	1,862,147
Ores (principally iron).....	1,600,483	1,750,548	2,229,470	1,436,792
Nitrate.....	2,565,572	2,554,565	1,910,793	1,375,450
Sugar.....	577,781	717,931	920,399	1,033,013
Canned goods (fish, fruit, vegetables, etc.).....	771,793	921,217	806,365	876,644
Metals, various.....	626,683	671,500	666,057	557,498
Food products in cold storage ¹	288,952	315,675	335,061	384,526
Fruit, fresh.....	93,457	211,854	144,880	286,049
Fruit, dried.....	272,644	304,956	206,384	282,791
Barley.....	237,262	260,142	275,064	235,364
Beans.....	127,168	154,782	112,679	171,335
Wool.....	167,931	150,712	145,071	157,129
Coffee.....	132,862	136,369	102,646	149,215
Flour.....	112,191	110,183	103,486	146,640
Rice.....	47,756	113,606	89,795	116,330
Paper.....	49,657	62,191	101,422	114,301
Copra.....	83,143	119,586	109,172	113,587
Pulp.....	14,734	49,623	108,861	109,163
Cotton.....	95,724	109,825	103,408	95,622
Oats.....	64,388	44,115	21,123	92,812
Cocoanut oil.....	29,862	68,206	95,034	76,971
Borax.....	86,933	74,089	91,921	70,913
Skins and hides.....	73,587	66,158	64,449	66,975
All other.....	871,220	937,410	1,076,466	1,019,281
Total.....	21,320,575	20,780,486	20,554,507	18,402,371

¹ Does not include fresh fruit.

As will be noted from the preceding tabulation, a great majority of the commodities routed from the Atlantic to the Pacific during 1931 decreased in comparison with the previous year, there occurring only five increases among the commodities listed in the table. The increases were in the items of cotton, coffee, slag, salt, and rosin. Nineteen of the 32 items listed in the Atlantic to Pacific movement for 1931 were lower in 1931 than in any of the other three years reported.

As in previous years, cargo from Pacific to Atlantic exceeded greatly that moving in the opposite direction. In 1931 the cargo from the Pacific was nearly three times that from the Atlantic; in the previous fiscal year the cargo from the Pacific was slightly over twice that from the Atlantic. Movement decreased in 1931 in comparison with 1930 in both directions but much more heavily in the shipments from the Atlantic.

There were seven items of cargo exceeding a million tons each in the past year, as follows: Mineral oils, lumber, wheat, ores (principally iron), nitrates, manufactures of iron and steel, and sugar. In 1930 there were six items in the million-ton class, which included all the aforementioned except sugar. In the movement from the Pacific to the Atlantic there were 16 commodities (included in the table above) which showed increases and 9 which showed decreases in comparison with 1930. Of the 16 increases, 11 were in food products—wheat, sugar, canned goods, cold storage products, etc. Notwithstanding the majority of individual increases there was a decrease in the aggregate tonnage in this direction of over 2,000,000 tons on account of heavy decreases in the important items of mineral oils, lumber, ores, and nitrates.

Atlantic to Pacific.—Manufactures of iron and steel, as in the past, constituted the largest classification of the movement in this direction, accounting for 19.8 per cent of the total cargo from the Atlantic to the Pacific, in comparison with 22 per cent of the total in 1930. In actual tonnage there was a decrease of 808,621 tons, or 38 per cent, in comparison with the previous year. The major decreases were in the United States intercoastal trade which declined 457,711 tons, or 37.2 per cent; 129,831 tons, or 54.2 per cent in the trade between the United States and Far East (including the Philippine Islands); and 75,947 tons, or 46.6 per cent, in the trade between Europe and South America.

Mineral oils from the Atlantic to the Pacific totaled 485,520 tons, in 1931, a decrease of 197,222 tons, or 28.9 per cent, in comparison with the previous fiscal year. The most marked decrease was in the shipments of kerosene which fell off 122,009 tons, or 41 per cent, and occurred principally over the route from the United States to the Far East.

Phosphates, the larger portion of which is shipped to the Far East from the United States, declined 123,069 tons, or 28.2 per cent, in comparison with the previous fiscal year.

Cotton, with 298,877 tons, increased 50,532 tons, or 20.3 per cent, over the previous fiscal year. Of the total shipments, 292,769 tons were reported as en route from the Gulf or South Atlantic ports of the United States to the Far East. The increase over this route in comparison with 1930 was 49,370 tons, or 20.3 per cent.

Pacific to Atlantic.—Since the beginning in the fiscal year 1923 of shipments of mineral oils on a large scale from the California fields, this product has been the leading commodity shipped from the Pacific to the Atlantic. As pointed out in the report of last year, this item of cargo reached its high point in 1924 with 9,721,446 tons. In 1925 the shipments declined to 5,989,622 tons and in 1926 they were slightly lower, with 5,930,716 tons. The year 1927 saw an increase to 7,143,165 tons, followed by decreases in 1928 and 1929. In 1930 shipment of mineral oils aggregated 5,700,587 tons, the highest since 1927. In the past year they decreased to 4,824,338 tons, the lowest for any fiscal year since 1923 when 4,334,664 tons were reported. In comparison with 1930 the past year's mineral oil tonnage from Pacific to Atlantic decreased 876,249 tons, or 15.4 per cent. Of this decrease 547,455 tons, or 16.2 per cent, occurred in the United States intercoastal trade, and 436,661 tons, or 31.2 per cent, in the trade between the United States and Europe. The trade between the United States and the West Indies showed an increase in this business of 102,344 tons, or 119.3 per cent, over the preceding year.

Lumber, with 2,747,485 tons in 1931, ranked as the second largest commodity. It has held second place since 1922 with the exception of one year (1923), when it dropped to third place in favor of nitrates. In comparison with 1930 the shipments of this commodity declined 783,394 tons, or 22.2 per cent. Of this decrease 412,471 tons, or 18.7 per cent, occurred in the United States intercoastal trade, 173,377 tons, or 32.4 per cent in the trade between the United States and Europe, and 97,765 tons, or 29.3 per cent, between Canada and the United States. Lumber from Canada to Europe did a little better than hold its own during the year, registering an increase of 9,194 tons, or 5.5 per cent. A little over 65 per cent of the total lumber shipments during the year were in the United States intercoastal trade.

Wheat, which occupied fifth place in 1930, moved to third place in 1931, surpassing the shipments of both ores and nitrates. The shipments of wheat, which have fluctuated notably during the past 10 years, reached their high mark in 1928 when 3,035,884 tons were carried through the canal. In 1929 these shipments dropped to 2,365,555 tons and in 1930 to 1,503,035 tons. In 1931 the shipments increased to 1,862,147 tons, or 359,112 tons (23.9 per cent) greater

than the shipments in 1930. About 80 per cent of the wheat shipments passing through the canal in 1931 went from the west coast of Canada to Europe.

The shipments of ores (the greater portion of which is iron ore shipped from Chile to the United States) showed a marked reduction in comparison with 1930, decreasing from 2,229,470 tons to 1,436,792 tons, a decline of 792,678 tons, or 35.6 per cent. The peak for ore shipments from the Pacific to the Atlantic was the 2,229,470 tons in 1930.

Nitrate shipments from the Pacific to the Atlantic, practically all of which originated in Chile, aggregated 1,375,450 tons in 1931, constituting the lowest tonnage for this commodity since 1927, when 1,174,384 tons were reported as passing through. In comparison with 1930 the shipments of nitrates declined 535,343 tons, or 28 per cent. Shipments to Europe (which were 66 per cent of the total nitrate tonnage in 1931) decreased 242,316 tons, or 21 per cent, and those to the United States (which were 33 per cent of the total) showed a decline of 172,298 tons, or 27.5 per cent. Shipments to Egypt, which were 123,487 tons in 1930, proved a negligible factor in 1931, that area absorbing only 8,270 tons.

Shipments of sugar, which have been increasing steadily for the past several years, increased 112,614 tons, or 12.2 per cent, over 1930. These increases occurred principally in five trades, as follows: United States intercoastal, 16,643 tons, or 15.4 per cent; South America to Europe, 42,172 tons, or 25.8 per cent; Australasia to Europe, 20,796 tons, or 90.5 per cent; Philippine Islands to United States, 25,220 tons, or 4.8 per cent; and Hawaiian Islands to the United States, 27,167 tons, or 36.4 per cent. Fifty-two and nine-tenths per cent of the sugar tonnage routed from the Pacific to Atlantic through the Panama Canal in 1931 was from the Philippine Islands to the United States; 19.9 per cent from South America to Europe; 12.1 per cent in the United States intercoastal trade; 9.9 per cent from the Hawaiian Islands to the United States; and 4.2 per cent from Australasia to Europe.

CLASSIFICATION OF VESSELS

Of the 5,529 commercial vessels transiting the canal during the fiscal year, 3,932 were steamers, 1,571 were motor ships, and the remaining 26 were motor schooners, sailing ships, barges, etc. For the past five years the proportions of these classes have been as follows:

	1927	1928	1929	1930	1931
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Steamers.....	85.3	84.8	80.2	76.8	71.1
Motor ships.....	11.9	13.8	19.3	22.8	28.4
Miscellaneous.....	2.8	1.4	.5	.4	.5
Total.....	100.0	100.0	100.0	100.0	100.0

As will be noted in the above table, the proportion of motor ships in the traffic through the canal has been increasing from year to year. The actual numbers of transits of motor ships in the past five fiscal years have been as follows: 1927, 654; 1928, 890; 1929, 1,240; 1930, 1,411; 1931, 1,571.

Of the 3,932 steamers transiting the canal during the past fiscal year, 2,862 burned oil, 1,008 burned coal, and 62 were reported as fitted for either fuel. For the past five fiscal years the proportions of each class have been as follows:

	1927	1928	1929	1930	1931
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Oil burning.....	70.8	63.8	64.0	72.2	72.8
Coal burning.....	28.3	35.7	34.7	26.4	25.6
Either oil or coal.....	.9	.5	1.3	1.4	1.6
Total.....	100.0	100.0	100.0	100.0	100.0

LADEN AND BALLAST SHIPS

A classification of the traffic during the fiscal year 1931 by laden ships, those in ballast, and tolls-paying vessels which are not of the cargo type, is as follows:

	Atlantic to Pacific			Pacific to Atlantic		
	Number of ships	Panama Canal net tonnage	Tolls	Number of ships	Panama Canal net tonnage	Tolls
Tank ships:						
Laden.....	37	180,163	\$182,913.14	473	2,664,142	\$2,737,370.45
Ballast.....	419	2,375,538	1,715,214.95	15	65,030	46,821.60
General cargo ships:						
Laden.....	1,943	9,887,933	8,771,644.95	2,186	10,774,409	9,788,466.10
Ballast.....	370	1,706,684	1,232,330.21	20	38,788	27,949.24
Noncargo-carrying ships:						
Passenger.....	2	24,161	20,075.00	4	63,628	47,750.00
Naval.....	5		38,464.00	5		27,910.50
Yachts.....	22	4,579	3,358.44	19	3,970	2,925.78
Tugs.....	4	352	231.00			
Launches.....				1	60	43.20
Lighthouse tenders.....	1	400	293.25			
Dredges.....	1	1,240	924.48	1	1,049	755.28
Hulls.....				1	20	15.00
Total.....	2,804	14,181,050	11,965,449.42	2,725	13,611,096	12,680,007.15

A classification of the commercial traffic during the fiscal year 1931 by laden ships and those in ballast, divided between tankers and general cargo vessels, and showing the ships not designed to carry cargo, is as follows:

Classification	Atlantic to Pacific	Pacific to Atlantic	Total
Tank ships, laden:			
Number of transits.....	37	473	510
Panama Canal net tonnage.....	180, 163	2, 664, 142	2, 844, 305
Tolls.....	\$182, 913. 14	\$2, 737, 370. 45	\$2, 920, 283. 59
Cargo, tons.....	218, 723	4, 884, 113	5, 102, 836
Tank ships, ballast:			
Number of transits.....	419	15	434
Panama Canal net tonnage.....	2, 375, 538	65, 030	2, 440, 568
Tolls.....	\$1, 715, 214. 95	\$46, 821. 60	\$1, 762, 036. 55
General cargo ships, laden:			
Number of transits.....	1, 943	2, 186	4, 129
Panama Canal net tonnage.....	9, 887, 933	10, 774, 409	20, 662, 342
Tolls.....	\$8, 771, 644. 95	\$9, 788, 466. 10	\$18, 560, 111. 05
Cargo, tons.....	6, 461, 706	13, 518, 258	19, 979, 964
General cargo ships, ballast:			
Number of transits.....	370	20	390
Panama Canal net tonnage.....	1, 706, 684	38, 788	1, 745, 472
Tolls.....	\$1, 232, 330. 21	\$27, 949. 24	\$1, 260, 279. 45
Noncargo-carrying ships:			
Passenger vessels—			
Number of transits.....	2	4	6
Panama Canal net tonnage.....	24, 161	63, 628	87, 789
Tolls.....	\$20, 075. 00	\$47, 750. 00	\$67, 825. 00
Naval vessels—			
Number of transits.....	5	5	10
Displacement tonnage.....	76, 928	55, 821	132, 749
Tolls.....	\$38, 464. 00	\$27, 910. 50	\$66, 374. 50
Yachts—			
Number of transits.....	22	19	41
Panama Canal net tonnage.....	4, 579	3, 970	8, 549
Tolls.....	\$3, 358. 44	\$2, 925. 78	\$6, 284. 22
Tugs—			
Number of transits.....	4	—	4
Panama Canal net tonnage.....	352	—	352
Tolls.....	\$231. 00	—	\$231. 00
Launches—			
Number of transits.....	—	1	1
Panama Canal net tonnage.....	—	60	60
Tolls.....	—	\$43. 20	\$43. 20
Lighthouse tenders—			
Number of transits.....	1	—	1
Panama Canal net tonnage.....	400	—	400
Tolls.....	\$293. 25	—	\$293. 25
Dredges—			
Number of transits.....	1	1	2
Panama Canal net tonnage.....	1, 240	1, 049	2, 289
Tolls.....	\$924. 48	\$755. 28	\$1, 679. 76
Hulls—			
Number of transits.....	—	1	1
Panama Canal net tonnage.....	—	20	20
Tolls.....	—	\$15. 00	\$15. 00

SUMMARY

Total cargo ships, laden:			
Number of transits.....	1, 980	2, 659	4, 639
Panama Canal net tonnage.....	10, 068, 096	13, 438, 551	23, 506, 647
Tolls.....	\$8, 954, 558. 09	\$12, 525, 836. 55	\$21, 480, 394. 64
Cargo, tons.....	6, 680, 429	18, 402, 371	25, 082, 800
Total cargo ships, ballast:			
Number of transits.....	789	35	824
Panama Canal net tonnage.....	4, 082, 222	103, 818	4, 186, 040
Tolls.....	\$2, 947, 545. 16	\$74, 770. 84	\$3, 022, 316. 00
Total tank ships:			
Number of transits.....	456	488	944
Panama Canal net tonnage.....	2, 555, 701	2, 729, 172	5, 284, 873
Tolls.....	\$1, 898, 128. 09	\$2, 784, 192. 05	\$4, 682, 320. 14
Cargo, tons.....	218, 723	4, 884, 113	5, 102, 836
Total general cargo ships:			
Number of transits.....	2, 313	2, 206	4, 519
Panama Canal net tonnage.....	11, 594, 617	10, 813, 197	22, 407, 814
Tolls.....	\$10, 003, 975. 16	\$9, 816, 415. 34	\$19, 820, 390. 50
Cargo, tons.....	6, 461, 706	13, 518, 258	19, 979, 964
Total noncargo-carrying ships:			
Number of transits.....	35	31	66
Panama Canal net tonnage.....	30, 732	68, 727	99, 459
Displacement tonnage.....	76, 928	55, 821	132, 749
Tolls.....	\$63, 346. 17	\$79, 399. 76	\$142, 745. 93
Grand totals:			
Number of transits.....	2, 804	2, 725	5, 529
Panama Canal net tonnage.....	14, 181, 050	13, 611, 096	27, 792, 146
Displacement tonnage.....	76, 928	55, 821	132, 749
Tolls.....	\$11, 965, 449. 42	\$12, 680, 007. 15	\$24, 645, 456. 57
Cargo, tons.....	6, 680, 429	18, 402, 371	25, 082, 800

DATA IN STATISTICAL SECTION

Further particulars of the traffic through the canal are presented in Section V of this report in the form of tables and graphs.

DUAL MEASUREMENT SYSTEM

Tolls on commercial vessels using the canal are levied on the basis of \$1.20 per net ton, on net tonnage as determined under the Panama Canal rules of measurement, for laden ships, and \$0.72 per net ton, measured under the canal rules, for ships in ballast, with the limitation that the amount collectible shall not exceed \$1.25 per net ton or be less than \$0.75 per net ton as determined under the rules for measurement for registry in the United States.

The effect of this is, generally, that tolls on laden vessels are usually paid on the basis of \$1.25 times the United States net tonnage and tolls on ballast vessels at \$0.72 times the Panama Canal net tonnage. In a few cases the product of \$1.20 times the canal net is slightly less than \$1.25 times the United States net, and tolls are paid on the canal basis; there are other cases of ships in ballast in which the Panama Canal net tonnage times \$0.72 is in excess of \$1.25 times the United States net, in which case the latter figure is the amount collectible. Such vessels pay less than \$0.72 per net ton, canal measurement, for transit either in ballast or laden. On small vessels such as tugs the United States rules sometimes indicate negative net tonnage, and such vessels make the transit without payment of tolls.

This dual basis is complex and unsatisfactory, frequently inequitable, and the canal administration has recommended repeatedly the adoption of the single Panama Canal basis. The reasons for the change are set forth at more length in Section III of this report, under the head of "Administrative problems."

The use of rates of \$1.20 for laden ships, and 72 cents for ships in ballast, times the net tonnage as determined under the Panama Canal rules, would have the effect of increasing heavily the charges on traffic; and in order that approximately equal revenue might be obtained, the canal administration has proposed that if the canal rules be adopted the rates should be set at approximately \$1 per net ton for laden ships and \$0.60 for vessels in ballast. However, the plan has met opposition from American operators of general cargo vessels for the reason that it would in most cases increase the charges against general cargo ships when laden. On the other hand, the proposed basis would reduce the charges on vessels making the transit in ballast. Hence, as applied to the total traffic using the canal the effect of adopting the canal rules and proposed rates, in comparison with revenues now derived, may vary according to the composition of the traffic.

In the discussions of the proposed adoption of the Panama Canal basis there have been statements to the effect that the change would impose undue burdens on United States vessels. The following is a comparison of the increases in tolls which would have been paid by United States vessels and by all vessels other than those of United States registry in the past five fiscal years:

UNITED STATES VESSELS ONLY

Fiscal year	Tolls actually collected	Tolls which would have been collected on proposed basis	Increase	
			Actual	Per cent
1927-----	\$12, 720, 447. 95	\$12, 601, 622. 60	¹ \$118, 825. 35	¹ 0. 93
1928-----	12, 645, 880. 20	12, 662, 378. 60	16, 498. 40	. 13
1929-----	12, 299, 584. 70	12, 471, 487. 00	171, 902. 30	1. 40
1930-----	13, 220, 662. 70	13, 537, 324. 60	316, 661. 90	2. 40
1931-----	11, 425, 999. 31	11, 883, 318. 60	457, 319. 29	4. 00
Total for 5 years-----	62, 312, 574. 86	63, 156, 131. 40	843, 556. 54	1. 35

ALL VESSELS OTHER THAN UNITED STATES

1927-----	\$11, 508, 382. 16	\$11, 720, 617. 30	\$212, 235. 14	1. 84
1928-----	14, 298, 619. 57	14, 583, 094. 40	284, 474. 83	1. 99
1929-----	14, 827, 792. 21	15, 518, 947. 60	691, 155. 39	4. 66
1930-----	13, 856, 227. 31	14, 795, 367. 00	939, 139. 69	6. 78
1931-----	13, 219, 457. 26	14, 264, 637. 30	1, 045, 180. 04	7. 91
Total for 5 years-----	67, 710, 478. 51	70, 882, 663. 60	3, 172, 185. 09	4. 68

¹ Decrease.

In the following table are shown, for the fiscal year 1931, the tolls paid by the vessels of various nationalities using the canal, in comparison with the tolls which they would have paid on the proposed basis. There is also shown the pro rata per net ton, Panama Canal measurement, of the actual tolls on laden and ballast vessels. For example, the laden Japanese ships paid tolls equivalent to an average of \$1.042 per net ton of capacity as determined under Panama Canal rules and on ballast traffic the equivalent of \$0.729 per Panama Canal net ton. British vessels, while paying essentially the same ballast equivalent, averaged \$0.90 per canal net ton on laden ships. It will be noted that for vessels in ballast the prevailing charge was close to 72 cents per Panama Canal net ton, with the exception of the Chilean vessels. Wider variations occurred in the charges on the laden vessels; the average rate per Panama Canal net ton ranged from \$0.727 for Panamanian vessels to \$1.208 for Peruvian vessels, a variation of \$0.481. On the assumption that the Panama Canal rules for the determination of net tonnage are an accurate basis for the just levy of canal dues, it is obvious that the present use of the United States rules is resulting in inequities and injustices, since the ships are not paying at equal rates on net tonnage as determined

under the canal rules of measurement. A Belgian average, for example, is 16.1 cents higher than the Dutch. The United States average is 10.5 cents under the Japanese but higher than the British by 3.7 cents, than the German by 7.6 cents, etc. The table follows:

Nationality	Tolls actually collected under present dual system	Tolls that would have been collected under proposed rates of \$1 laden and 60 cents ballast on basis of Panama Canal net tonnage	Difference		Pro rata per Panama Canal net ton of tolls actually collected		
			Increase	Decrease	Laden	Ballast	Total
Belgian.....	\$116,452.51	\$115,513.80		\$938.71	\$0.983	\$0.720	\$0.936
British.....	6,580,987.70	7,004,853.80	\$423,866.10		.900	.721	.869
Chilean.....	166,782.50	184,834.40	18,051.90		.894	.512	.894
Colombian.....	17,840.61	15,157.20		2,683.41	1.175	.732	1.149
Danish.....	519,535.67	559,392.80	39,857.13		.887	.713	.850
Danzig.....	165,459.25	151,918.00		13,541.25	1.036	.720	.895
Dutch.....	473,269.39	568,885.20	95,615.81		.822	.720	.818
French.....	523,263.93	590,884.60	67,620.67		.870	.721	.858
German.....	1,204,084.62	1,377,118.40	173,033.78		.861	.721	.853
Greek.....	26,342.87	27,876.60	1,533.73		.894	.720	.851
Italian.....	404,674.43	458,732.60	54,058.17		.872	.728	.864
Japanese.....	1,052,413.33	1,006,620.80		45,792.53	1.042	.729	1.032
Norwegian.....	1,403,922.86	1,579,366.40	175,443.54		.831	.714	.803
Panamanian.....	60,204.86	79,951.80	19,746.94		.727	.721	.727
Peruvian.....	8,565.60	7,088.00		1,477.60	1.208	.720	1.208
Spanish.....	22,053.99	21,001.70		1,052.29	1.004	.720	.901
Swedish.....	424,924.05	466,158.00	41,233.95		.839	.722	.804
United States.....	11,425,999.31	11,883,318.60	457,319.29		.937	.723	.907
Yugoslavian.....	48,679.09	49,283.20	604.11		.938	.720	.877
Total.....	24,645,456.57	26,147,955.90	1,567,985.12	65,485.79	.913	.721	.884
Total difference, increase of.....			1,502,499.33				

A bill to remedy these inequalities has been introduced in Congress. This is discussed under the heading of Administrative Problems, Section III.

AVERAGE TONNAGE, TOLLS, AND TONS OF CARGO PER VESSEL

The average measurement tonnage, tolls, and tons of cargo per vessel transiting the canal during the past three fiscal years are shown in the following tabulation:

Feature	Fiscal year, 1929	Fiscal year, 1930	Fiscal year, 1931
Measured tonnage:			
Panama Canal net.....	4,653	4,847	5,027
United States equivalent.....	3,554	3,667	3,725
Registered gross.....	5,842	6,052	6,192
Registered net.....	3,571	3,686	3,756
Tolls.....	\$4,230.06	\$4,377.83	\$4,457.49
Tons of cargo (including vessels in ballast).....	4,781	4,855	4,537
Tons of cargo (laden vessels only).....	5,711	5,712	5,405

It will be noted from the above that there have been increases in the average measurement tonnage and average tolls in the past three years, which have been due to the gradual addition of new and larger vessels to several lines plying through the canal. The increase in

the average net tonnage, Panama Canal measurement, of vessels transiting in 1931 in comparison with 1930 was 3.7 per cent and in comparison with 1929, 8 per cent, while the average United States equivalent net tonnage per vessel increased only 1.6 per cent and 4.8 per cent, respectively, over 1930 and 1929. The increase in the average tolls per vessel was 1.8 per cent over 1930 and 5.4 per cent in comparison with 1929.

The average cargo per vessel transiting (including in the total the vessels which made the transit in ballast) decreased in the fiscal year 1931 to the extent of 6.5 per cent in comparison with the preceding year and 5.1 per cent in comparison with 1929. Considering the laden vessels only, the average cargo per vessel decreased in 1931 by 5.4 per cent of the average in 1930 and the same percentage with reference to 1929, as the average for 1929 and 1930 varied by only 1 ton.

HOURS OF OPERATION

Dispatching of ships through the canal is conducted on schedules. Vessels ready to leave for transit begin moving through the canal from each end at 6 o'clock in the morning, and dispatches are made thereafter from each end at intervals of about half an hour. The following is a summary of the arrangements in effect at the end of the fiscal year.

OPERATING HOURS FOR COMPLETE TRANSIT

From Cristobal Harbor, first ship at 6 a. m., last at 2.30 p. m.; from Balboa anchorage, first ship at 6 a. m., last at 2 p. m. This applies to vessels averaging 10 to 12 knots; in case of a vessel capable of 15 knots, departure may be made up to 3 p. m. from Cristobal or Balboa.

LIMITS FOR STARTING ON PARTIAL TRANSIT

After the last through ships have been dispatched, and provided there is no interference with approaching traffic, ships are started on partial transit from Cristobal Harbor up to 9 p. m. or from Balboa anchorage up to 7 p. m. Partial-transit ships tie up on reaching the summit level and continue the following morning; the first of those bound for the Pacific leaves Gatun at approximately 3.45 a. m., and the first of those bound for the Atlantic leaves Pedro Miguel at 3.30 a. m., providing the air is sufficiently free of fog or rain to allow safe navigation.

Two ships usually, sometimes three, each way, can be given the benefit of partial transit each day, and under ordinary conditions they gain from two to three hours. When traffic is heavy it is impracticable to use partial transits, as they would then interfere with the regular schedule

Tankers with inflammable cargoes are dispatched at the discretion of the captain of the port and are not permitted to proceed unless they can clear Gaillard Cut before dark. Overloaded tankers carrying gasoline cargo are restricted to schedules leaving at 7, 7.30, and 8 a. m.

The volume of traffic at present is not such as to make advisable continuous operation throughout the 24 hours of the day, or even extensive night operation. Such operation would not only involve greater expense and increase the difficulties of maintenance of locks and channel but it is somewhat objectionable from the shipmasters' point of view on account of the hazards of navigation in restricted channels under conditions of darkness, made worse by rains and fogs. Fogs over the cut and lake usually fall before midnight and are dissipated by 8 o'clock in the morning.

LOCKAGES AND LOCK MAINTENANCE

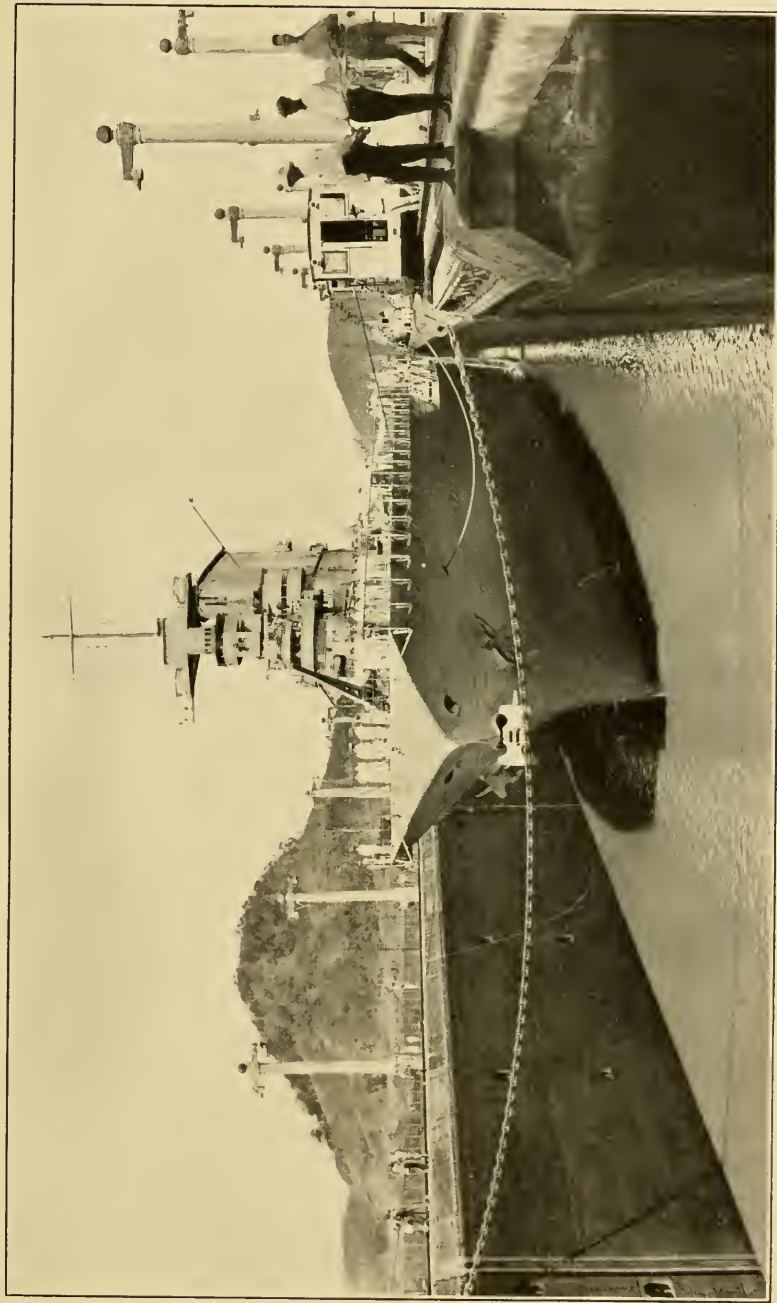
The average number of lockages per day was 15.26 at Gatun Locks, 15.96 at Pedro Miguel, and 15.84 at Miraflores. The total number at all locks was 17,178, as compared with 18,909 during the fiscal year 1930 and 19,087 during the fiscal year 1929. The decrease during the past year was 1,731, or 9.2 per cent.

GATUN LOCKS

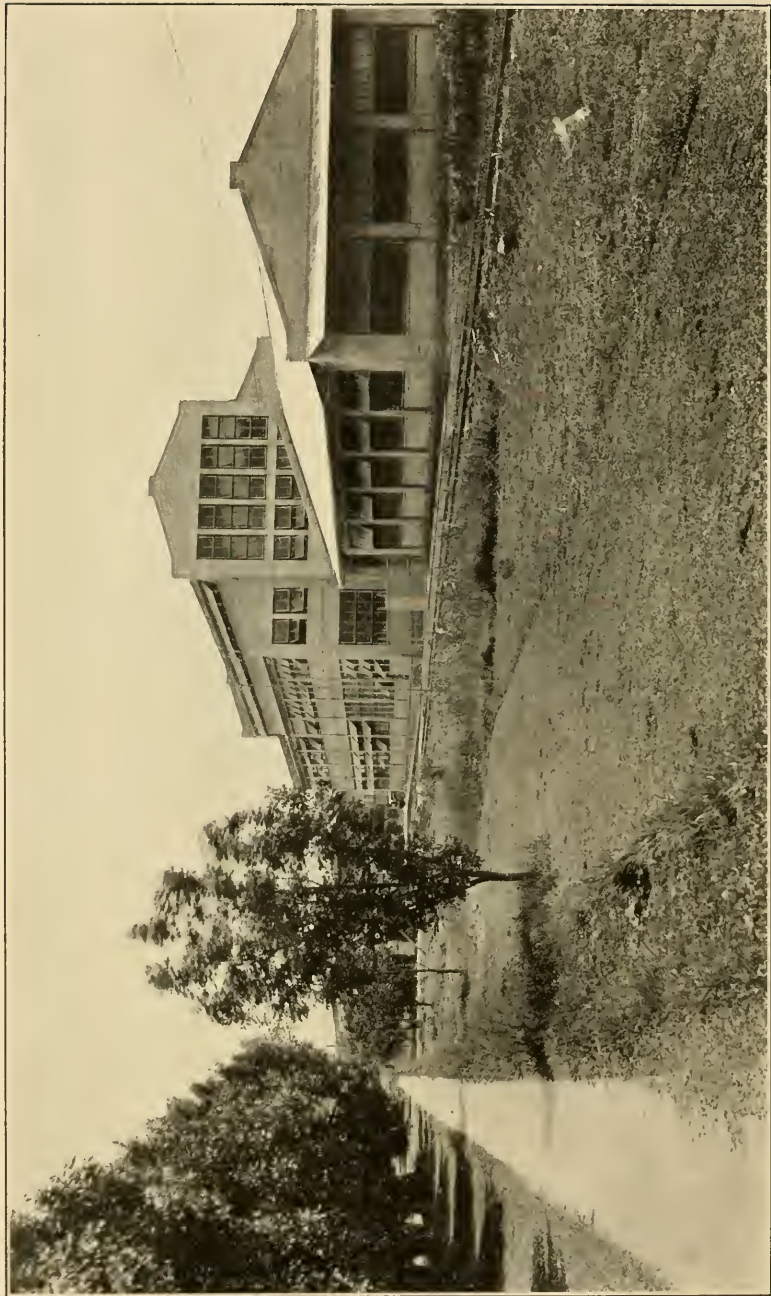
The quadrennial overhaul of Gatun Locks was begun on January 7 and completed on April 10, after a working period of three months two and one-half days. In addition to the routine work performed during the overhaul, eight miter gates were jacked up and rolled out from wall for renewal of pintles, bushings, and all bearing plates. Nineteen new cylindrical valves and bodies were installed in the upper level of the center wall, which completes the replacement of the old type valve. The new type cylindrical valves installed in 1927 showed no particular wear, neither did the bronze seat rings installed in 1924 and 1927.

All rising stem valves, except the guard valves, were removed and necessary repairs were made. New front wearing pads and roller train track wearing plates were installed on 48 valves. Side seals were renewed on all valves. New design roller trains were installed with all valves. All gates were renamed, sills, fenders, and seals being renewed where necessary. In general the condition of the underwater equipment was good, considering a 4-year run.

Apart from the overhaul, the machinery, equipment, and structures were maintained in good condition and daily operations continued as outlined in previous reports. During the overhaul period when one flight was out of service, the operations for the transit of vessels were on a continuous 24-hour basis. Some delays to ships occurred, as was to be anticipated from the conditions.



UNITED STATES NAVY AIRPLANE CARRIER "SARATOGA" IN PEDRO MIGUEL LOCK



ELECTRICAL DIVISION FIELD OFFICE AND SHOPS, BALBOA

PACIFIC LOCKS

The operation of the Pacific Locks continued on the same basis as heretofore, except that during the period of the Gatun Locks overhaul Pedro Miguel Locks were manned by double crew shifts from 7 a. m. to 10.40 p. m. Routine maintenance and repairs were performed on all machines and equipment during the year, electric cable being renewed as found necessary. A new power cable was installed through the lower crossunder at Miraflores and necessary oil switches and bus work were installed in order to make the necessary changes to switch the lighthouse circuit to Miraflores substation, with an auxiliary feed from Miraflores Locks.

Lockages and vessels handled, by months, during the past fiscal year are shown in the following table, to which is appended for comparison a statement of the totals during the past five fiscal years:

	Gatun		Pedro Miguel		Miraflores		Total	
	Lockages	Vessels	Lockages	Vessels	Lockages	Vessels	Lockages	Vessels
1930								
July.....	480	559	503	576	501	583	1,484	1,718
August.....	470	536	495	554	490	553	1,455	1,643
September.....	457	530	473	522	471	519	1,401	1,571
October.....	521	553	534	592	531	585	1,586	1,760
November.....	481	546	498	567	497	568	1,476	1,681
December.....	486	548	509	562	510	561	1,505	1,671
1931								
January.....	479	576	504	617	501	614	1,484	1,807
February.....	452	541	473	559	466	562	1,391	1,662
March.....	474	597	501	592	495	593	1,470	1,782
April.....	445	535	468	546	463	540	1,376	1,621
May.....	425	478	444	517	441	511	1,310	1,506
June.....	401	448	422	463	417	462	1,240	1,373
Total.....	5,571	6,477	5,824	6,667	5,783	6,651	17,178	19,795
Fiscal year:								
1927.....	5,467	6,641	5,783	6,968	5,691	6,941	16,941	20,550
1928.....	6,314	7,406	6,642	7,811	6,577	7,804	19,533	23,021
1929.....	6,289	7,428	6,473	7,994	6,325	7,934	19,087	23,356
1930.....	6,135	7,164	6,436	7,430	6,338	7,431	18,909	22,025
1931.....	5,571	6,477	5,824	6,667	5,783	6,651	17,178	19,795

The number of vessels locked per lockage in the fiscal year 1931 averaged as follows: Gatun, 1.163; Pedro Miguel, 1.145; Miraflores, 1.150. The average for the total of 17,178 lockages was 1.152 vessels. For the four previous years, from 1927 to 1930, inclusive, the corresponding ratios have been, respectively, 1.213, 1.179, and 1.165.

POWER FOR CANAL OPERATION

The power system was operated throughout the entire year with an average combined generator output of 5,497,708 kilowatt-hours per month, as compared with an average of 5,442,508 per month for the previous year. An average of 5,120,672 kilowatt-hours per month was distributed from substations, as compared with a corresponding figure of 4,937,522 kilowatt-hours per month last year, an increase of 183,150 kilowatt-hours, or 3.7 per cent. Transmission

and distribution loss was 6.82 per cent this year, as compared with a corresponding loss during 1930 of 9.27 per cent.

The Gatun hydroelectric station operated throughout the year, carrying the full load of the power system except at times of peak load when the Miraflores Diesel electric station came in on the line and during the dry-season months when the water-driven generators at this station were restricted in their operation to conserve water in the lake. This began on January 10, 1931, when one engine unit at Miraflores was placed on the system under full load. The second unit under full load was placed on the system on February 17, and 2-engine load was carried until March 15, when one engine was taken off. The remaining engine was shut down on March 24, from which date the station resumed regular stand-by and peak-load relief service. In the three months, January to March, inclusive, the output of the hydroelectric station totaled 11,390,050 kilowatt-hours, and that of the Diesel station 6,263,400 kilowatt-hours. In the month of greatest transference of load, February, the output of the hydroelectric station was 2,990,200 and of the Diesel station 2,458,600 kilowatt-hours. Water consumption by the hydroelectric station in February was 2,287,408,336 cubic feet as compared with its normal consumption under full load of over 4,000,000,000 cubic feet per month.

There were eight interruptions to transmission-line service during the year from the following causes: Lightning, 2; animals, 2; train wreck, 1; operating error, 1; and 2 from causes undetermined.

Operation and maintenance of the spillway of Gatun Lake are performed by the electrical division. During the year there were 302 gate operations, of which 180 were for lake regulation, 2 for exhibitions, 72 for sanitation, 16 for photographs, and 32 for maintenance purposes.

One thousand one hundred and sixty-three electric ranges were received during the fiscal year and 945 of this number installed in quarters throughout the various districts.

General maintenance work in connection with the telephone system, distribution and maintenance of lines and appliances, fire-alarm signal system, and railway signal system were carried on during the year.

WATER SUPPLY

The inflow of water into Gatun Lake from all sources and the utilization and losses of the water in the lake are summarized in the following table. There are also shown the percentages which each item formed of the total yield or total consumption. The data are presented for the fiscal years 1930 and 1931, the former for comparison; each year covers 12 months, ending June 30, and thus embraces the cycle of both dry and rainy seasons:

	Billion cubic feet fiscal year		Per cent of total fiscal year	
	1930	1931	1930	1931
Run-off above Alhajuela.....	63.52	61.38	40.1	41.8
Yield from land area below Alhajuela.....	61.24	50.17	38.6	34.1
Direct rainfall on lake surface.....	33.78	35.40	21.3	24.1
Total yield.....	158.54	146.95	100.0	100.0
Evaporation from lake surface.....	20.72	21.55	13.1	14.6
Gatun Lake lockages.....	40.04	38.79	25.2	26.4
Hydroelectric power.....	45.45	45.38	28.7	30.9
Spillway waste.....	53.83	32.83	33.9	22.3
Municipal, leakage, etc.....	1.60	1.69	1.0	1.2
Change in volume in storage.....	-3.10	+6.71	-1.9	+4.6
Total uses and losses.....	158.54	146.95	100.0	100.0

NOTE. — — indicates decrease in storage, + an increase.

DRY SEASON

The 1931 dry season, from a water-supply standpoint, began December 16, 1930, and ended May 13, 1931. The total duration was 149 days. This is 24 days longer than the average dry season, which begins about January 1 and ends about May 5. During the past 24 years there have only been four dry seasons of longer duration, those of 1912, 1920, 1921, and 1926. The net yield of the Gatun Lake watershed was 717 cubic feet per second compared with an 18-year average of 832 c. f. s., or 14 per cent below the average. The total yield of the lake's watershed was 1,522 c. f. s., of which the Chagres River furnished 58 per cent.

Gatun Lake fell from elevation 87.03 feet to 82.14 feet. This drop of 4.89 feet represented a loss from storage of 22.3 billion cubic feet. One unit at the Miraflores Diesel electric plant was operated for 46 days and two units for 27 days, saving approximately 0.90 feet of water on Gatun Lake. Water saving at the canal locks amounted to approximately 0.45 feet on the lake. The total water saved during the dry season was thus about 1.35 feet. The momentary elevation of the lake on May 13, 1931, was 82.08 feet, so that had the above saving not been made the lake would have dropped below elevation 81 feet.

MADDEN DAM PROJECT

Investigations, tests, and explorations were concluded during the first six months of the fiscal year and reports covering this work were furnished the consulting engineers, Mr. R. F. Walter, chief engineer, and Mr. J. L. Savage, chief designing engineer, Bureau of Reclamation. On recommendation of the consulting engineers the services of Dr. Frederick L. Ransome, consulting geologist of Pasadena, Calif., and Mr. A. J. Wiley, civil engineer of Boise, Idaho, were secured. All of these gentlemen visited the Isthmus from December 24, 1930,

to January 3, 1931, and a report setting forth their conclusions and recommendations was submitted to the governor under date of January 8, 1931.

After a careful study of the consultants' report and consideration of all data collected on the project, it was decided that the main dam should be a straight gravity type concrete dam, and that the working level of the reservoir would be elevation +240 feet above mean sea level, with the extreme high-water level reaching elevation +263. It was further decided that work on the design and specifications for the project would proceed more rapidly if it were performed in the office of the Bureau of Reclamation at Denver, Colo., with the assistance of the bureau's staff. Funds were transferred to the Bureau of Reclamation for the expense which would be incurred; and in February, 1931, the designing engineer of the Panama Canal organization for the project proceeded to Denver, accompanied by three assistants, to assist in the design and to represent the governor.

The designs and specifications for the main dam, the left ridge dam, the saddle dams, and the power plant were completed in June, and the work was advertised June 15, 1931, for bids to be opened September 1, 1931.

Design of the power-plant machinery and equipment progressed satisfactorily, but was not completed by the close of the fiscal year. However, contract drawings for the power-generator equipment and specifications for the purchase of the machinery were completed and approved.

Designs and specifications for construction plant were begun, for use in the event that none of the bids for construction of the project should prove acceptable and it should become necessary to execute the work by forces of the Panama Canal.

GENERAL DESCRIPTION OF PROJECT

The principal features of the Madden Dam project will comprise the main dam across the Chagres River, the power plant, the left ridge dam, and 13 saddle dams.

The main dam will consist of an overflow spillway section across the river and the left and right abutment sections. It will be about 950 feet long on the crest and about 220 feet in height at the maximum section from the lowest point of the foundation to the top of the roadway. The dam is to be built in sections about 56 feet in length, formed at the ends to key them together, and the resulting contraction joints will be provided with systems of pipes for pressure grouting after shrinkage has taken place in the concrete.

Excavation for the base of the dam is to be carried well into solid rock, and a cut-off trench will be excavated below the upstream heel. Grout holes spaced not less than 5 feet are to be drilled in the bottom

of this trench to depths varying from about 20 to considerably over 100 feet, and after concrete has been placed in the trench and to a depth of at least 8 feet over the adjacent foundation of the dam, grout will be applied under pressure. An earth blanket will be placed on the stripped bedrock on the upstream side of the dam for almost the full width of the spillway section and for a distance of 150 feet upstream. Concrete aprons will be constructed on the bedrock immediately upstream from the abutment sections, these varying in length from 150 feet, where they join the earth blanket, to 30 feet at the ends of the abutments.

The spillway will be divided into four 100-foot openings by three concrete piers, and structural-steel drum gates 18 feet high will be installed on the concrete crests in these openings. The bridge over the spillway will consist of flat concrete arches spanning the gate openings. Six rectangular conduits through the base of the spillway section will serve as sluice outlets, three plate-steel power penstocks and an additional opening for a future power penstock and two plate-steel discharge pipes for operation outlets will be embedded in the left abutment section at the power-plant location. The opening for the future power penstock will be closed by a reinforced concrete bulkhead on the upstream face of the dam and by a reinforced concrete wall on the downstream slope of the dam. Each conduit through the spillway section will be controlled by two 5-foot 8-inch by 10-foot hydraulically operated slide gates arranged in tandem. The flow through each of the discharge pipes in the abutment section will be regulated by an 84-inch needle valve installed at the outlet end in the power house. Each needle valve and power turbine will be protected by a 132-inch remote-controlled, motor-operated, emergency butterfly valve installed in the respective discharge pipe or power penstock at about the axis of the dam. The inlet ends of all conduits through the dam, including power penstocks, will be protected by concrete and structural-steel trash racks.

The power plant will be located immediately downstream from the river end of the left abutment section. The power plant will consist eventually of three units, each of about 8,000 kilowatts capacity, but only two units will be installed now. The power house will be constructed by the contractor and the power penstocks will be installed by him, but the hydraulic and electrical machinery in the power plant will be installed by the Government.

The left ridge dam is to be practically a continuation of the Madden Dam on the south, and will have a length of about 3,300 feet and a maximum height of approximately 44 feet on the axis. It will consist of earth and gravel and rock fills. The upstream face will be protected by concrete paving. A counterforted concrete retaining wall will support the fills at the right end of this dam.

Saddle dams Nos. 5 and 8 will consist of earth and gravel and rock fills, and the upstream faces will be protected by a 2-foot thickness of dumped igneous rock riprap over 12 inches of gravel. Saddle dam No. 5 will be approximately 430 feet long and will have a maximum height of 53 feet on the axis, while saddle dam No. 8 will be approximately 900 feet long, with a maximum height of about 42 feet. Concrete core walls will be constructed from anchorages in the impervious rock below the bases of the dams to elevations above the water level. The 11 other saddle dams will be of earth and gravel and rock fill, without core walls and without riprap on the upstream slopes. The maximum height on the axes of these dams will vary from 3 to 25 feet. Trenches filled with earth core material will be extended down to the impervious material below the bases of all but one of the smaller dams.

LANDS

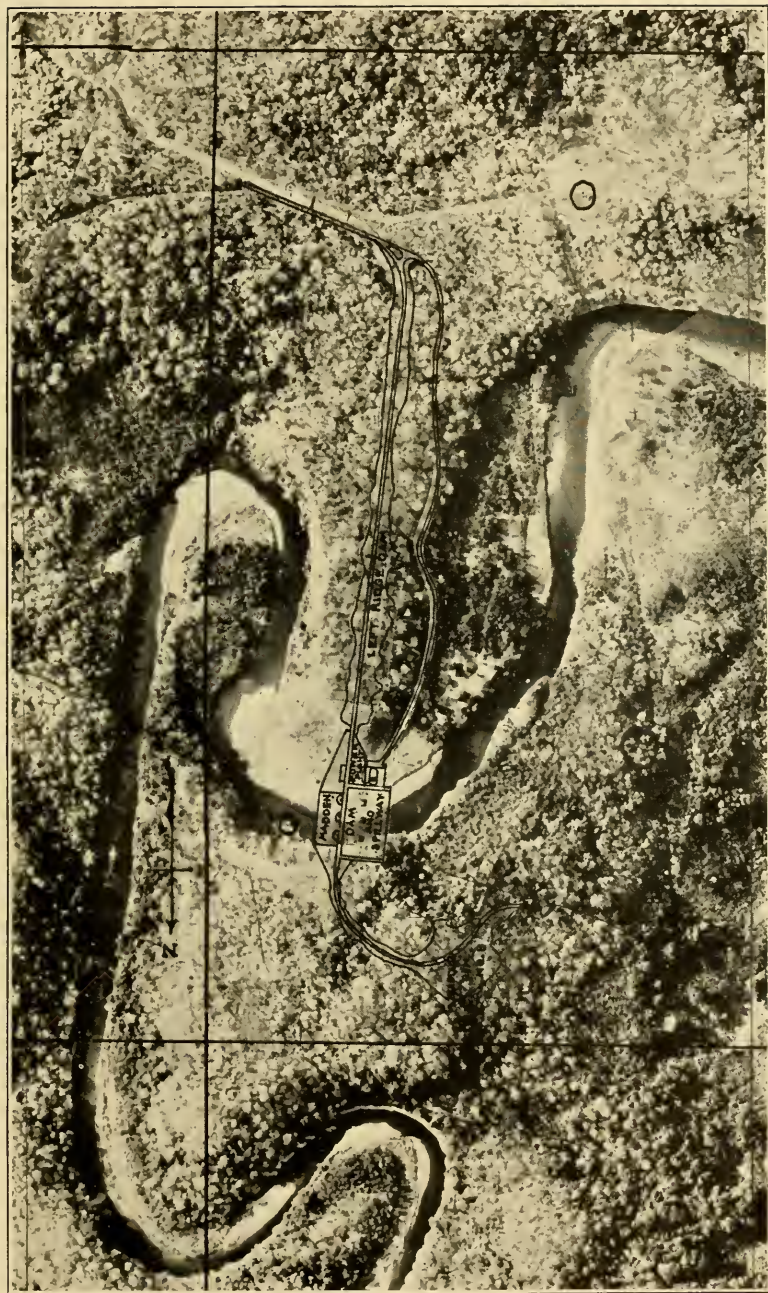
The survey of additional land to be acquired for the project was completed. Formal notification to the Government of the Republic of Panama of the necessity to acquire an area of 1,981.8 acres, or 802 hectares, on the left bank of the Chagres River, and an area of 506.6 acres, or 205 hectares, on the right bank of the river, was given by the United States Minister to Panama on November 10, 1930, and jurisdiction was assumed over this area on April 15, 1931.

POWER TRANSMISSION LINE

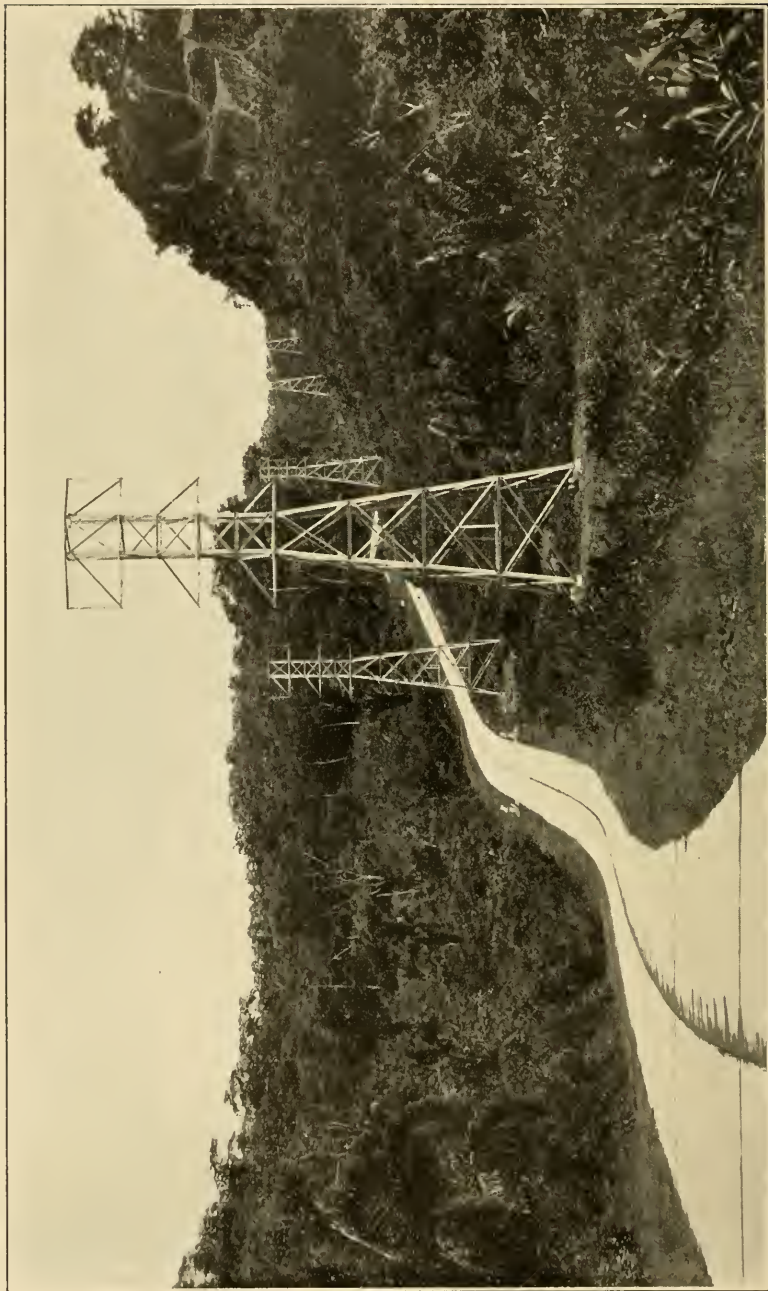
For the purpose of supplying electric power for construction purposes and later to provide for the transmission of power generated at the Madden Dam power house, when completed, it is necessary to construct a high-voltage transmission line from Summit to the dam site. Erection of the 84 towers necessary to carry the line was nearly completed at the end of the fiscal year. The line runs parallel to the Madden Road, on its west side. The towers are designed to carry 66,000 volts on two 3-wire circuits of No 2-0 stranded copper wire, although for present construction purposes it is intended to transmit at 44,000 volts. The existing substation at Summit was being moved at the end of the fiscal year to the junction of the present trans-Isthmian transmission line and the Madden Road to accommodate the line at that point, and a temporary substation was being constructed near the dam site to provide electric power during the construction period of the project.

OTHER PRELIMINARY WORK

Other preliminary work necessary to construction was carried out during the year, such as road construction, installation of telephone lines, surveying and mapping of the reservoir area and adjacent



AERIAL PHOTOGRAPHIC MAP OF MADDEN DAM SITE



MADDEN DAM PROJECT; TRANSMISSION LINE TOWERS, NEAR QUEBRADA ROQUE, LOOKING TOWARD SUMMIT. JUNE, 1931

territory, clearing and grubbing of dam site, left ridge and principal saddles, and the construction of quarters for the Government inspection forces.

SEISMOLOGY

Forty-five seismic disturbances were recorded on the seismographs at Balboa Heights during the year ending June 30, 1931, as compared with 28 in the fiscal year 1930 and 64 in the fiscal year 1929. Of the 45 disturbances recorded in 1931, 9 were of comparatively close origin, the distance to the epicenter being estimated at less than 100 miles. Two of these, occurring on July 30, 1930, and March 7, 1931, were generally felt locally and the walls of several buildings were cracked but no material damage was done. Of the quakes of relatively close epicenters, that which was recorded on March 31, 1931, as within the 500-mile radius, was the shock which destroyed the city of Managua, Nicaragua.

MAINTENANCE OF CHANNEL, AND IMPROVEMENT PROJECTS

Dredges were at work throughout the year on maintenance of the canal channel in the Atlantic and Pacific entrances, Gatun Lake, Gaillard Cut, and Balboa inner harbor; auxiliary dredging in Folks River for France Field fill and stock pile for the Army, and for Colon fill. Excavation during the fiscal year is summarized in the following table:

Location	Earth	Rock	Total
From canal prism:			
Atlantic entrance (maintenance).....	281,000	0	281,000
Gatun Lake (maintenance).....	10,850	1,450	12,300
Project No. 3, Gatun Lake section.....	53,200	45,400	128,600
Project No. 3, Gaillard Cut section.....	126,700	406,250	532,950
Project No. 4, Gatun Lake section.....	9,050	36,600	45,650
Project No. 4, Gaillard Cut section.....	1,250	4,400	5,650
Project No. 5, Gaillard Cut section.....	45,400	218,800	264,200
Gaillard Cut (maintenance including slide).....	179,650	399,450	579,100
Projects Nos. 1 and 1-B (Pacific entrance).....	1,057,750	649,700	1,737,450
Pacific entrance (maintenance).....	3,628,700	44,950	3,673,650
Total, canal prism.....	5,453,550	1,807,000	7,260,550
Auxiliary:			
Project No. 1-A (Balboa inner harbor).....	144,900	108,550	253,450
Balboa inner harbor (maintenance).....	2,040,400	51,100	2,091,500
Dock 4 (Pacific entrance).....	600	1,200	1,800
France Field and Army stock pile.....	280,000	0	280,000
Colon fill.....	788,100	0	788,100
Gatun Lake (M. S. Lochmonar).....	15,750	15,700	31,450
Total, auxiliary.....	3,269,750	176,550	3,446,300
Grand total.....	8,723,300	1,983,550	10,706,850

Dredging operations at the canal are recorded by three major districts: The northern district, from the contour 42 feet below mean sea level in the Atlantic Ocean to Gamboa; the central district, Gaillard Cut, from Gamboa to Pedro Miguel Locks; the southern

district, from Pedro Miguel Locks to contour 50 feet below mean sea level in the Pacific Ocean. Excavation in these three districts is summarized as follows:

	Canal prism			Auxiliary			Total		
	Earth	Rock	Total	Earth	Rock	Total	Earth	Rock	Total
Northern....	384, 100	83, 450	467, 550	1, 083, 850	15, 700	1, 099, 550	1, 467, 950	99, 150	1, 567, 100
Central.....	353, 000	1, 028, 900	1, 381, 900	0	0	0	353, 000	1, 028, 900	1, 381, 900
Southern.....	4, 716, 450	694, 650	5, 411, 100	2, 185, 900	160, 850	2, 346, 750	6, 902, 350	855, 500	7, 757, 850
Total..	5, 453, 550	1, 807, 000	7, 260, 550	3, 269, 750	176, 550	3, 446, 300	8, 723, 300	1, 983, 550	10, 706, 850

In addition to the excavation outlined in the foregoing, 26,331 cubic yards of sand were excavated from the beach near Chame, Panama, and delivered at Balboa.

CANAL IMPROVEMENT WORK

Improvement project No. 1.—Work of deepening the Pacific entrance channel from Miraflores Locks to the sea buoys and the Balboa inner harbor from -45 feet to a ruling depth of -50 feet, mean sea level datum, known as improvement project No. 1, was begun in the harbor in July, 1924, and in the Pacific entrance in November, 1924. Work has been carried on continuously since that time as equipment has been available. During the past fiscal year work on this project was performed by the pipe-line suction dredges *No. 86* and *Las Cruces*, handling the softer materials, and by the dipper dredges *Gamboa* and *Cascadas*, excavating hard earth and rock.

Project No. 1-A involves widening the channel to the eastward to a straight line connecting the southwest corner of Dock 6 with the northwest corner of Dock 4; dredge area between east prism line and within 15 feet of face of Dock 4; widen channel to eastward to a line extending southward from the face of Dock 4 to station 2263+00, and from this station deflected to intersect the east prism line at station 2280+00, all to a ruling depth of 50 feet, mean sea level.

Project No. 1-B.—On the west side, widen the channel to the westward by 300 feet between station 2251+25 and station 2281+50 with appropriate easements into the present channel, starting on the north end at the intersection of the west prism lines at the P. I., station 2243+30, and on the south end at station 2300+00 to a ruling depth of 50 feet, mean sea level.

Total excavation to date on improvement project No. 1 is 6,976,250 cubic yards, of which 2,340,700 cubic yards are anticipated fill and 398,500 cubic yards from project No. 1-B.

Project No. 3.—This project consists of widening the channel at the north entrance to Gaillard Cut and extending northward, terminating

at the south end of Gamboa Reach; it also provides a tie-up station opposite Gamboa, as an extension of the original plan.

The dipper dredge *Paraiso*, with auxiliary equipment, worked six months on this project during the year, excavating 532,950 cubic yards of material in the Gaillard Cut section and 128,600 cubic yards of material from the Gatun Lake section. The total excavation on this project to the end of the fiscal year was 753,900 cubic yards of material. At that time the excavation on the project was 42 per cent completed.

Project No. 4.—This project consists of widening the channel opposite Gamboa bridge on the east side, starting at the south end with an easement approach curve, station 1483+00, joining up with a reverse curve 120 feet from and paralleling center line of Gamboa bridge at station 1479+00, terminating on the north end with an easement approach to the project between stations 1469+50 and 1465+50, at which point the new prism line runs tangent to the old. Total excavation to date on this project is 51,300 cubic yards. At the end of the fiscal year the excavation was 54 per cent completed.

Project No. 5 (revised).—This project consists of widening the Gaillard Cut approach to Pedro Miguel Locks; eliminating reverse bend from Paraiso Reach into Cucaracha Reach to increase the field of vision along Paraiso and Cucaracha Reaches, including free line of sight to Cucaracha signal station from the west chamber of the locks. Project starts on south end at station 1920+50 and new west prism line is projected northward paralleling center approach wall of locks to station 1913+23, at which point a 1°-2' curve continues to station 1900+00, thence continuing in a straight line to station 1868+50, being tangent to old west prism line at this station. The project also involves the removal of a ridge to an elevation of plus 128 feet, mean sea level. This will permit a clear view of Paraiso and Cucaracha Reaches, as well as Cucaracha signal station, from the bridge of a ship immediately on leaving the west chamber of Pedro Miguel Locks. Work was started on this project in December, 1930. The dredge *Gamboa*, with auxiliary equipment, worked for four months on this project, excavating 264,200 cubic yards of material. At the end of the fiscal year the excavation on this project was 29 per cent completed.

AUXILIARY DREDGING

During the year the following auxiliary work was performed in addition to canal improvement and maintenance work:

France Field fill.—Suction dredge *No. 86*, working three months and assisted by relay pump barge for 54½ days, excavated a total of 262,000 cubic yards of sand, coral, and silt from Folks River borrow pit; in making a hydraulic fill of approximately 82.5 acres on this project. Of the total yardage excavated, 191,800 cubic yards were

put on the field during the fiscal year and 21,200 cubic yards in the preceding fiscal year, making a total fill in place of 213,000 cubic yards covering 90.5 acres.

Stock pile, United States Army.—Suction dredge No. 86 excavated 18,000 cubic yards of coral and sand from the Folks River borrow pit which was placed in a stock pile for the United States Army at France Field.

Colon fill.—Preliminary work on this fill, which extends from Ninth to Eleventh Streets, and from G Street to Shore Road, Colon, was continued from the previous year. Excavation was begun with suction dredge No. 86 in November, 1930, and the fill was completed in April, 1931. A total of 788,100 cubic yards of sand, coral, and blue clay were excavated from Folks River borrow pits for this work. The area of the completed fill was 37 acres.

Dredging around grounded vessel.—At about 2 p. m., March 31, 1931, the motorship *Lochmonar* of the Royal Mail Steam Packet Co., a vessel of 9,412 gross tons, 485.5 feet long, 62-foot beam with a mean authorized draft of 29 feet 6 inches, ran aground in the canal in San Pablo Reach, north of Buoy 67, during northbound transit, due to an error in executing order from canal pilot. In order to refloat the vessel the dipper dredge *Paraiso* excavated a 40-foot channel the full length of the vessel on both sides. With the assistance of four tugs the vessel was reloaded at 6 p. m., April 7, 1931. A total of 31,450 cubic yards of material was excavated by the dredge in refloating the vessel.

DISPOSITION OF EXCAVATED MATERIAL

Canal prism and auxiliary material dredged during the year was deposited on the following dumps and fills: 1,599,900 cubic yards on dumps located in Gatun Lake north of Gamboa; 2,985,300 cubic yards on the Pacific sea dumps; 1,444,800 cubic yards in area C, Corozal; 1,411,200 cubic yards in areas E and F on west side of canal; 1,286,850 cubic yards on Piquero fill, west of Balboa; 114,600 cubic yards in the Rio Grande north of Balboa Harbor; 7,000 cubic yards north of mole, Dock 13, Balboa; 508,100 cubic yards on right-of-way of Thatcher Highway; 281,000 cubic yards in Limon Bay west of channel; 280,000 cubic yards on France Field fill and stock pile; 788,100 cubic yards on Colon fill. In addition, 26,331 cubic yards of Chame beach sand were delivered alongside dock at Balboa in barges for canal uses.

EQUIPMENT

The following floating equipment was employed during the fiscal year: Three 15-yard dipper dredges, operated for 334 days, 229 days, and 149 days, respectively; one 20-inch pipeline suction dredge, 354 days; one 24-inch pipeline suction dredge, 305 days; 1 hydraulic

grader, 210 days; one relay pump barge, 240 days; two drill boats, 300 days each; one air compressor, 330 days; crane boat *La Valley*, entire year; the 250-ton floating cranes *Ajax* and *Hercules* were operated alternate months except when calls for extra service required the commissioning of both cranes; five large tug boats were operated during the year, one or two of the five in turn being under repairs or held in reserve; and miscellaneous small craft were used in auxiliary service.

On the dredge *Gamboa* the single three and one-quarter inch main hoist cable was changed to twin two and one-quarter inch cables. The superiority of this arrangement over the old single main-hoist split dipper stick was evidenced both in smooth operation and reduced operating costs.

While drill boat *Terrier No. 2* was laid up for general overhaul, the old middle tower and drill were removed and a new 75-foot tower was installed. The drill was replaced with an improved hammer type pneumatic drill together with necessary auxiliary equipment, portable air compressor, etc., for test purposes. At the end of the fiscal year tests had not been completed but results obtained indicated the great superiority of this drill over the old piston type now in use.

SLIDES

Slides in the banks of Gaillard Cut were fairly active during the year but at no time caused interference with shipping. The following summarizes the slide movements during the fiscal year:

East Cascadas slide.—A slight movement occurred on the waterfront during July, 1930, between stations 1596+00 and 1597+00 E. Total excavation to date from this slide is 50,145 cubic yards.

West Whitehouse slide.—There has been no movement of this slide during the year. The dipper dredge *Paraiso* excavated 2,200 cubic yards of material remaining in this area from a slide which occurred the previous year. Total excavation to the end of the year on this slide is 158,960 cubic yards.

South West La Pita slide.—With the exception of a slight surface movement over this area during the period from July to September, 1930, this slide has been quiescent during the year. The dipper dredge *Paraiso* excavated 5,400 cubic yards of material from this area. Total excavation to the end of the year from this slide is 38,850 cubic yards.

West Lirio slide.—On July 26 and August 25, 1930, breaks occurred on this slide between stations 1735+00 and 1740+00 W. This slide extended from 200 to 400 feet back from the new prism line at elevations from 60 to 100 feet above the lake level. Material pushed over the west prism for 80 feet with depths of 20 to 30 feet on the prism line. There has also been a general settlement along the water's edge between stations 1721+00 and 1725+00 W. The dipper dredge

Paraiso worked $45\frac{1}{2}$ days on the slide, removing 171,750 cubic yards of material. The surface movement continued over the slide until December, 1930. There has been no further movement since that date. Total excavation to June 30, 1931, on this slide is 2,409,270 cubic yards.

East Lirio slide.—No movement occurred during the year. Total excavation to the end of the year on this slide is 399,912 cubic yards.

East barge repair slide.—On July 10, 1930, part of the Lirio culvert, head wall, and apron broke down and 25,000 cubic yards of material entered the canal. This material pushed out over the east prism line for 65 feet between stations 1746+00 and 1749+50 E. The dipper dredge *Paraiso* worked 8 days on this slide, excavating 26,950 cubic yards of material. There was no further movement during the year. Total excavation to the end of the year on this slide is 624,800 cubic yards.

East Culebra slide.—There was no movement on the East Culebra slide during the year.

West Culebra slide.—There has been a slow continuous movement of this slide during the year. The reference points on this slide showed only a slight movement. The dipper dredges *Paraiso* and *Gamboa* excavated 65,600 cubic yards of material from areas fronting this slide. Total excavation to the end of the year on both the East and West Culebra slides is 29,443,860 cubic yards. Some new breaks developed on the south slope of Zion Hill from 900 to 1,400 feet west of stations 1791+00 and 1797+00 W.

Cucaracha slide.—No movement occurred during the year. Total excavation to the end of the year from this slide is 9,299,752 cubic yards.

Cucaracha signal station slide.—A general surface movement occurred over the old area of this slide during October and November, 1930. In May, 1931, the 95-foot berm, consisting of hard rock, broke away between stations 1828+00 and 1830+50 W. and came into the prism, shoaling out beyond the west prism line for about 50 feet. The dipper dredges *Paraiso* and *Gamboa* excavated 44,350 cubic yards of material at this point. Total excavation to June 30, 1931, from this slide is 235,700 cubic yards.

South Cucaracha slide.—There was a slight surface movement over this slide in October and November, 1930. The dredge *Paraiso* excavated 14,300 cubic yards of material between stations 1717+00 and 1725+00 E. Total excavation to the end of the year on this slide is 142,350 cubic yards.

Cucaracha village slide.—There was no movement of this slide during the year. The dredge *Paraiso* cleaned up 4,000 cubic yards of material from a previous slide at this point. Total excavation to the end of the year on this slide is 110,800 cubic yards.

Cartagena slide.—Eight observation points were placed on this slide and observed daily during May and June, 1931. This area, covering 5.6 acres, showed a slow settlement during these months. The dredge *Gamboa* excavated 62,400 cubic yards of material from this slide during the year. Total excavation to June 30, 1931, on this slide is 108,650 cubic yards.

Miscellaneous slides.—There were many small breaks at various points throughout the cut during the fiscal year, but these, like the major slides, caused no interference with shipping.

FERRY SERVICE

The vehicular ferry across the canal at the north end of Pedro Miguel Locks, between the east and west banks of the canal, was in daily operation throughout the year, making a total of 16,190 trips and carrying 75,939 vehicles, as compared with 60,287 in 1930, 40,868 in 1929, and 26,452 in 1928. By months the number of vehicles transported ranged from 4,341 in June to 10,365 in April with an average of 6,328. The 10,365 vehicles carried in April were the largest number transported during any month since the operation of the ferry was assumed by the Panama Canal, on October 8, 1927. This service was operated on a continuous schedule between the hours of 6 a. m. and 9 a. m., and from 5 p. m. to 9 p. m., and hourly round trips were made between the hours of 9 a. m. and 5 p. m.

The Diesel-engined ferry boats built by the mechanical division are to be used at Pedro Miguel until the opening of the Thatcher Highway, and at the end of the year it was expected that the *President Roosevelt*, the first to be completed, could be placed in operation about August 1, supplanting the steam tug and barge and giving more efficient and economical service.

AIDS TO NAVIGATION

The lighthouse subdivision, in addition to the regular maintenance work on the lights, buoys, and beacons in the canal and adjacent waters, effected the following installations, changes, and additions to the aids to navigation during the year: Improvements were made on the Taboguilla Light, and a new standard tank house was erected in connection with it. A green light was installed on the center line target midway between front range No. 27 and rear range No. 28 at the north end of Bas Obispo Reach. The west breakwater beacon at the Atlantic entrance to the canal was rebuilt, being replaced by a more modern light of the same characteristics. A new standard tank house was installed at the east breakwater beacon, Atlantic entrance to the canal. The two green lights at the

southwest and northeast corners of the oil dock in Balboa were discontinued and a red light was established in the center of the dock, about three feet above and facing the canal. Four lights were established on the west lighthouse circuits in the Pacific entrance at stations Nos. 2125, 2140, 2171, and 2190; these lights are on single piles driven in line with beacons 5 and 9 and are approximately 50 feet west of the west prism line and show a fixed white light approximately 6 feet above spring tides. South Fraile Light was changed from flashing white to flashing red. A new standard steel tank house was erected at the San Jose lighthouse in the Perlas Islands and new pipe lines were installed. Sun relays were installed on the electric lines feeding the beacons on the east and west banks of the canal north of Gatun Locks, eliminating manual operation from the control house of the locks.

Overhead transmission lines on the east and west banks of the canal at Balboa were replaced by a submarine cable. In the Siri Grande arm of Gatun Lake, $1\frac{1}{4}$ miles of channel were cleared and marked.

An act of Congress, approved February 25, 1929, authorized the Secretary of Commerce, subject to the consent of the Republic of Panama and suitable diplomatic arrangements for protecting the interests of the United States, to establish and maintain aids to navigation on Jicarita Island and on Morro Puercos in the approaches to the Panama Canal from the Pacific Ocean. After the necessary negotiations were made the work of erecting lights at these two points was performed for the Department of Commerce by the Panama Canal. This included the erection of towers and placing of lights. The work was begun at Morro Puercos on September 15, 1930, and at Jicarita Island on November 5, 1930, and the lights were placed in operation on November 2 and 22, respectively.

ACCIDENTS

The board of local inspectors conducted investigations and submitted reports on 73 accidents to vessels in transit through the canal or in its terminal ports. The number of accidents in which the estimated damages amounted to \$1,000 or more was 17, as compared with 17 in the fiscal year 1930. A classification of the 73 accidents shows the following: Struck lock walls or fenders, 23; struck wharves or wharf piling, 19; collision between ships, 6; damaged by canal tugs while being assisted, 5; grounded, 4; broke chocks in locks, 3; struck canal bank, 3; damage to ships' hawsers and rat-guards caused by speed of passing vessels, 2; propeller fouled by lock locomotive cable, 2; damaged through carrying away of fuel oil line while refueling, 1; tug lost mainmast while assisting ship, 1; vessel fouled by lock chain, 1; alleged damage while docking (not proven), 1; fuel-oil

handling equipment damaged when lines parted, 1; and buoy in canal fouled by vessel, 1.

Following is a brief summary of the more serious accidents, in chronological order:

Date	Vessel	Cause of accident	Estimated damage	Responsibility attributed to—
1930				
July 23	Jason.....	Struck float at Dock 17, Balboa.....	\$3,825	Vessel.
26	Armadales.....	Struck by canal tug Gorgona.....	1,500	Panama Canal.
Aug. 16	Vancouver City....	Struck wing wall, Miraflores Locks.....	4,300	Do.
Oct. 6	Castilla.....	Struck by steamship Damsterdyk while undocking with canal tug assisting.	1,325	Do.
26	Losmar.....	Struck center wall, Pedro Miguel Locks.....	1,200	Vessel.
Nov. 27	Napier Star.....	Struck west bank of canal.....	1,600	Do.
Dec. 1	Willboro.....	Collision with steamship Benvorlich in Gaillard Cut.	11,300	Panama Canal
	Benvorlich.....	Collision with steamship Willboro in Gaillard Cut.	32,000	Do.
1931				
Jan. 20	Agwiworld.....	Struck wing wall, Miraflores Locks.....	3,850	Vessel.
Feb. 2	Robt. Luckenbach..	Struck soft nose, Gatun Locks.....	1,300	Do.
23	H. M. S. Nelson.....	Struck chamber wall, Gatun Locks.....	1,400	Panama Canal,
23	do.....	Struck lock wall, Miraflores Locks.....	1,200	Do.
Mar. 1	Sun.....	Struck by canal supply boat No. 2.....	1,400	Do.
20	Pennsylvania.....	Struck lock wall, Gatun Locks.....	1,200	Do.
31	Lochmonar ¹	Grounded in San Pablo Reach.....	(?)	Vessel.
Apr. 10	Empress of Australia.	Struck wing wall, Pedro Miguel Locks.....	2,500	Do.
June 11	Pacific Cedar.....	Struck center wall, Gatun Locks.....	2,500	Do.

¹ Such interior examination of the Lochmonar as was possible, and exterior examination by diver, indicated that the vessel had sustained no damage as a result of grounding. Canal charges for salvage operations, dredging, lightering, tug service, etc., in refloating the vessel amounted to \$10,103.34. The vessel was delayed at the canal 10 days as a result of the grounding.

² Undetermined.

Under the established practice of requiring overdraft vessels to have the assistance of a tug in transit through the canal, tug service for this reason was furnished to 74 vessels bound from the Pacific to the Atlantic and to 2 bound from the Atlantic to the Pacific, a total of 76.

SALVAGE OPERATIONS

Commercial salvage companies have been operating in the areas adjacent to the canal since 1926, and upon the establishment of this arrangement the Panama Canal adopted a policy of not undertaking salvage operations in other than canal waters except where lives are endangered or great emergency exists. Canal equipment was not required for any salvage operations outside of canal waters during the fiscal year 1931. The Panama Canal tug *Favorite*, operated principally as a salvage vessel and lighthouse tender, towed the dredge *Peru* from Callao, Peru, to Cristobal for dry docking and thence to Cartagena, Colombia, under contract for the Gahagan Construction Co. The tow was accomplished without incident. Other minor tows, incident to traffic, were handled by this tug during the fiscal year.

RULES AND REGULATIONS

The rules and regulations for the navigation of the Panama Canal and adjacent waters effective January 1, 1926, issued under Executive order of September 25, 1925, were supplemented or amended during the year by three supplements referring to the following subjects: Maintenance and return to the United States of sick or injured American seamen; load and trim of vessels; partial transit through the canal; pilotage; insulated towing gear for vessels used for carrying liquids or solids giving off highly inflammable gases; vessels carrying explosives consigned to the canal; forward and after lights for self-propelled vessels from 26 to 65 feet in length; radio communication from vessels approaching from the Pacific on passing Cape Mala; routing of radio dispatches; passports or other identification papers for Chinese seamen; and modifications of the general information presented in Chapter XV of the rules and regulations.

SECTION II

BUSINESS OPERATIONS

A statement of the expenses (including depreciation), revenues, and profit or loss of various subsidiary business operations of the Panama Canal is presented in Section V of this report, Table No. 23. There are also shown in the table, for comparison, fixed capital charges at 3 per cent per year, except on public works in the cities of Panama and Colon, where the rate is figured at 2 per cent, in accordance with contract. These charges are not actually made against the several units of the organization but are calculated on the basis of the capital invested in them as a criterion to indicate their profits or losses in comparison with the standard of a return of 3 per cent on the capital.

The total net profit on these operations during the year was \$562,764.17 as compared with \$760,071.66 in the fiscal year 1930, a decrease of \$197,307.49, or 26 per cent. In 1929 the net profit was \$737,850.26.

The fixed capital charges at 3 per cent totaled \$836,574.88, indicating a discrepancy between the actual profits and the arbitrary standard of \$273,810.71. Based on the capital invested the net profit of \$562,764.17 showed a return on the investment of approximately 2 per cent.

The business operations of the Panama Railroad Co. on the Isthmus yielded an additional profit of \$991,383.72. In 1930 this figure was \$1,523,874.82. The decrease in 1931, in comparison, was \$532,491.10, or 35 per cent.

The activities of the major business units during the year are discussed briefly in the following paragraphs:

MECHANICAL AND MARINE WORK

The volume of work performed for the Panama Canal, which is the principal item in the work of the mechanical division shops, increased slightly over that during the preceding fiscal year, due principally to work for the locks and on dredging equipment and to the construction of two ferry boats. Work for other departments of the Government and for the Panama Railroad Co. both decreased in comparison with the fiscal year 1930. Work for individuals and companies, including that on ships transiting the canal or calling at the terminal ports, showed a slight increase but continued below the normal for years prior to 1930. For the five fiscal years 1925 to 1929, inclusive, the value of work for individuals and companies averaged approximately \$925,000 a year. Compared with this, the amount in 1930 and 1931 was about two-thirds of normal work.

The total volume of work for all interests decreased slightly in the past year in comparison with 1929 and 1930 and some reductions of force and furloughs without pay were made. The gold force has decreased about 5 per cent. Work in sight at the end of the fiscal year was sufficient to occupy the present force for the summer, but the outlook for the fall indicated further reduction of force.

The value and class of work done and the source of the same for 1931, as compared with the two preceding years, are shown in the following table:

	1929	1930	1931
AMOUNT OF WORK COMPLETED			
Marine.....	\$1,768,321.50	\$1,964,834.47	\$1,713,789.06
Railroad.....	620,390.50	648,139.44	633,279.48
Stock materials.....	484,449.51	309,803.58	307,117.44
Sundries.....	387,578.99	456,463.14	678,025.66
Total.....	3,260,740.50	3,379,245.63	3,332,211.64
ORIGIN OF WORK COMPLETED			
Individuals and companies ¹	810,335.67	614,458.01	632,378.02
The Panama Canal.....	1,350,375.87	1,408,778.89	1,518,041.62
Panama Railroad Co.....	668,010.21	758,293.95	676,367.39
Other departments of United States Government.....	432,018.75	597,714.78	505,424.61
Total.....	3,260,740.50	3,379,245.63	3,332,211.64

¹ Includes Panama Railroad steamship line

DRY DOCKS AND MARINE WORK

A total of 165 vessels were dry-docked during the year, 73 at Balboa and 92 at Cristobal. A classification of these vessels follows:

	Balboa	Cristobal	Total
Panama Canal equipment.....	26	4	30
United States Navy vessels.....	17	11	28
United States Army vessels.....	0	6	6
Other United States Government vessels.....	0	2	2
Panama Railroad vessels.....	0	6	6
Commercial line vessels.....	30	63	93
Total.....	73	92	165

The usual run of emergency and voyage repairs was carried out for commercial vessels both at Balboa and Cristobal during the year. In addition to these three, large hull damage jobs were successfully carried out at Balboa. The first of these was the steamship *Benvorlich*, where the port bow, including the deck and hull plating in way thereof, was ripped away in a collision with the steamship *Willboro* in Gaillard Cut. This job involved removal of both anchors and chain, removal of anchor windlass, casting and renewing of one hawse pipe and repairing the other, besides extensive renewal of the involved hull and deck plates. The work was completed in 18 days at a total

cost of \$23,000. This record could not have been made because of the lack of mechanics had not the division been engaged in the construction of two ferry boats. The next was the steamship *Condor* of the Grace Line, damaged in a collision off the Peruvian coast. This job entailed complete renewal of the starboard side of the hull in way of Nos. 1 and 2 hatches. It was completed in 31 days at a cost of \$49,000. The superintending engineer of the Grace Line stated that both time and money had been saved by having the work performed at the canal, and that the quality of the work could not be had in a commercial shipyard. Third was the renewal of the bottom (almost complete) of the steamship *Yomachichi*, a Shipping Board vessel, operated by the Roosevelt Steamship Co., which went aground on Cape Maysi, Cuba. This work was completed in 45 days at a cost of \$111,000.

As a part of the annual fleet maneuvers and for the purpose of testing the availability of the Panama Canal as a docking place for battleships, the U. S. S. *West Virginia* was successfully dry-docked for cleaning, painting, and under-water work. The only deficiency noted was the inability to furnish the vessel with an adequate supply of direct-current electricity from shore. The available equipment can supply only 25 kilowatts. While the Panama Canal can not be expected to supply the large quantity of direct current required by a battleship, adequate equipment can be installed to care for merchant ships and small warships.

Besides the usual overhauls and repairs to dredging division floating equipment, the conversion of the dipper dredge *Gamboa* from a single to a double hoist was completed during the year. The alteration proved very successful, so much so, in fact, that plans were made for similar conversion of the dredges *Cascadas* and *Paraiso*. The alterations were in accordance with plans furnished by the builder of the dredges.

The usual annual overhaul of marine division floating equipment was carried out and in addition a new class C launch, of a new pattern, specially designed for boarding parties, was built for that division.

The ferries *President Roosevelt* and *Presidente Amador* were built and launched during the year and are now nearing completion. It is expected that the *President Roosevelt* will be ready for service by August 1, 1931. These ferries, designed to serve as a crossing of the canal in Balboa Harbor for vehicular traffic between Panama City and the national highway system over the western half of the Republic of Panama, will each have a capacity of 30 passenger automobiles. They are 125 feet long, 38 feet wide over the guards, and draw slightly under 7 feet of water. The hull proper is 122 feet long between end posts, is of 30 feet molded beam, and has a molded depth of 10 feet

9 inches. The hull is powered with a 375-horsepower, direct-connected, 8-cylinder reversible Diesel engine manufactured in the United States.

Two rectangular-hold barges 84 feet long, 24 feet beam, 7 feet depth, with a rated capacity of 225 tons, were built for the Panama Railroad Co. during the year for use by the receiving and forwarding agency at Cristobal as cargo lighters.

OTHER WORK

The remaining two towing locomotives, of the four reported in the last annual report, were completed and turned over to the locks division. The manufacture of three more towing locomotives has been begun and has reached a point where all the castings have been made ready for machining. The nineteen 76-inch cylindrical valves, referred to in the last annual report, were completed and installed. The installation of these valves completed the replacement of all of the 120 old-type cylindrical valves with this new pattern which are fitted with renewable bronze seats and wearing shoes.

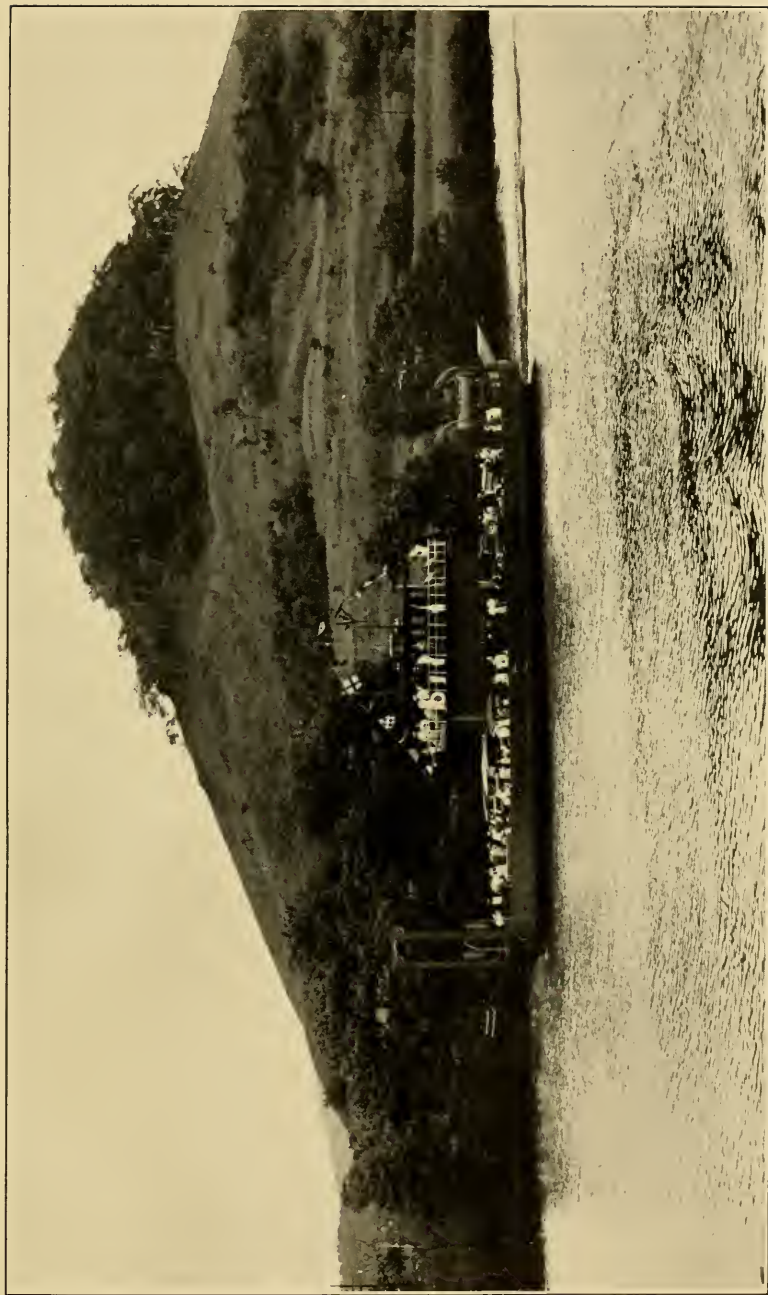
Work on the erection of one of the 1,000,000-gallon steel water tanks at Mount Hope was started at the end of the fiscal year. Two of these tanks are to be erected with a combined capacity of 2,000,000 gallons as additional provision for the water-supply system at the Atlantic end of the canal. These new tanks are made necessary by the increased population of the Cristobal-Colon district, particularly the Army and Navy posts, and the need of a large water reserve which can be called upon in the event of an emergency. The development will give a reserve and pressure storage of 2,000,000 gallons, as compared with the existing reserve of 500,000 gallons. The tanks are elevated, their bottoms about 154 feet above sea level, their tops approximately 35 feet higher.

Erection was also started at Mount Hope of a 13,600-barrel gasoline storage tank for the Texas Oil Co. This tank was fabricated in the United States and is being erected by the mechanical division.

The last of the four new passenger cars for the Panama Railroad, referred to in the last annual report, was completed during the year.

PLANT

The new machine shop and the combined forge, sheet metal, and pipe shop at Cristobal are now in regular use, having been entirely completed with the exception of one corner of the machine shop, where completion is obstructed by the temporary retention of the old power plant. The remaining portions of the old wooden buildings have been completely demolished. Of the new power plant, four bays, to house the electrical plant and air compressors, have been completed and temporary closure provided at the uncompleted end. Comple-



NEW FERRYBOAT "PRESIDENT ROOSEVELT" ON OPENING TRIP ACROSS CANAL. CERRO PARAISO IN BACKGROUND

tion of the remaining two bays, which will house the pumping plant for the enlarged dry dock, will await reconstruction of the dry dock, although the steelwork has been fabricated and closure and roofing materials are on hand. Installation of electrical equipment and air compressors is proceeding in the newly built power plant. The concrete building formerly occupied by a section of the Cristobal store has been vacated by the storekeeper and turned over to the mechanical division. It is being remodeled into a paint shop, rigging loft, mold loft, and sail loft, with space at the end for marine electricians. With this remodeling completed the old wooden buildings formerly used for these purposes will be demolished. Along with other work at the Cristobal shops, considerable filling and regrading, relocation of railroad tracks, and reconstruction of underground utilities has been accomplished.

FINANCIAL

The mechanical division earned net revenues of \$49,999.84 after making deductions for Cristobal shop improvements. Local reserves as of June 30, 1931, for repairs to equipment and buildings and for replacements of machinery and equipment, improvements to Cristobal shops, and gratuity for employees' leave totaled \$556,605.77, as compared with \$531,818.46 at the end of the fiscal year 1930.

COAL

The sales of coal from the plants at Cristobal and Balboa totaled 169,504 tons during the year, as compared with 282,569 tons during the year 1930 and 305,434 tons during 1929. The total revenue from the sale of coal and charges for extra handling during the fiscal year amounted to \$1,319,552.74. The total cost of sales, including operating expenses, was \$1,458,569.10, resulting in a net loss of \$139,016.36, as compared with a net profit of \$258,748.68 for the preceding year.

The decrease in coal sales in 1931 as compared with 1930 was approximately 40 per cent. The decrease in coal-burning ships transiting the canal was approximately 20 per cent (from 1,257 such ships in 1930 to 1,008 in 1931). The greater relative decrease in coal sales was due primarily to the fact that during the time of light cargoes many of the ships have been using vacant cargo space to carry extra bunker coal, loaded at ports in Europe or the United States where coal is cheap; this decreases the amount of bunkers to be loaded while on the voyage.

In continuation of the policy of filling Navy coal requirements from the dry-coal stock of the Panama Railroad on the Isthmus, 10,000 tons were transferred to the Navy during the year at the cost in pile to the railroad.

The selling prices of coal were reduced on December 2, 1930, from \$8 to \$7.25 per ton at Cristobal and from \$11 to \$10.25 at Balboa.

FUEL OIL, DIESEL OIL, GASOLINE, KEROSENE

During the fiscal year there was purchased and received on the Isthmus 323,952 barrels of fuel oil, of which 249,429 barrels were stored in tanks at Balboa and 74,523 barrels in tanks at Mount Hope. The total fuel oil handled by the Balboa and Mount Hope fuel-handling plants amounted to 12,120,522 barrels for 2,161 vessels, both receipts and issues. There is storage space available on the Isthmus for 2,441,040 barrels of fuel or Diesel oil, 1,246,540 barrels at Balboa and 1,194,500 barrels at Mount Hope.

Gasoline received during the year amounted to 3,722,951 gallons, 1,086,794 at Mount Hope and 2,636,157 at Balboa. There is storage space available on the Isthmus for 4,029,000 gallons of gasoline or kerosene, 1,272,000 at Mount Hope and 3,757,000 at Balboa.

There were also received on the Isthmus during the fiscal year 939,047 gallons of kerosene in bulk; 357,502 gallons were stored at Mount Hope and 581,545 gallons were stored at Balboa.

All deliveries to and from tanks, for private companies as well as for the Panama Canal and the United States Navy, continued to be handled during the year through the pipe lines and pumping plants of the Panama Canal at Balboa and Mount Hope (Cristobal).

FUEL AND DIESEL OIL

The business in fuel and Diesel oils during the fiscal year 1931 is summarized in the following tabulation:

	Balboa	Mount Hope	Total
Service to ships:			
Fuel oil sold to ships by Panama Canal, barrels.....	3,254	3,024	6,278
Fuel oil sold to ships by companies, barrels.....	1,203,673	2,750,300	3,953,973
Total sales to ships.....	1,206,927	2,753,324	3,960,251
Number of ships bunkered by Panama Canal.....	4	6	10
Number of ships bunkered by companies.....	475	874	1,349
Total ships supplied.....	479	880	1,359
Diesel oil sold to ships by Panama Canal, barrels.....	717	142	859
Diesel oil sold to ships by companies, barrels.....	1,325,623	319,131	1,644,754
Total sales to ships.....	1,326,340	319,273	1,645,613
Number of ships supplied by Panama Canal.....	4	6	10
Number of ships supplied by companies.....	440	142	582
Total ships supplied.....	444	148	592
Number of Panama Canal craft handled.....	57	60	117
Number of other ships handled.....	979	1,065	2,044
Total vessels handled.....	1,036	1,125	2,161
Aggregate handling of fuel and Diesel oil, barrels:			
Received by Panama Canal (fuel oil).....	249,430	74,744	324,174
Used by Panama Canal.....	209,054	97,850	306,904
Pumped for individuals and companies.....	5,178,536	6,180,553	11,359,089
Sold by Panama Canal.....	9,255	15,883	25,138
Transfers between tanks.....	35,369	69,848	105,217
Total barrels pumped.....	5,681,644	6,438,878	12,120,522

OBSOLETE AND UNSERVICEABLE PROPERTY AND EQUIPMENT

During the year disposition was made of \$472,274.94 worth of obsolete and unserviceable property and equipment by sale, or by destruction where the items had no money value. Replacement was made in all cases where conditions warranted.

SHIP CHANDLERY AND OTHER STOREHOUSE SUPPLIES

The operation of the storehouses was continued under the same policy as during preceding years, and inventory values were held down to the lowest practicable figure. The value of stock on hand at all storehouses at the end of the year, exclusive of scrap and obsolete materials, was \$4,959,523.22, and in the hands of canal and business divisions \$61,101.87, or a total of \$5,020,625.09. The total value of all materials received on requisition from the United States during the year was \$4,638,435.33. Local purchases were made to the extent of \$555,658.43. Scrap and obsolete stock remaining on hand at the end of the year were valued at \$59,259.33.

The general storehouse at Balboa (including the medical storehouse) and the branch storehouses at Paraiso and Cristobal handled a total of 155,829 requisitions and foreman's orders during the year. The value of all issues for the year was \$4,674,615.64. Material and supplies sold to steamships, employees, and others aggregated \$1,149,276.94, and involved 69,680 separate sales.

Native hardwood lumber operations were continued, as during the preceding year, and 425,076 board feet of logs were purchased, as compared with 326,069 board feet during 1930. In addition 4,179 hardwood crossties were purchased from local contractors.

PURCHASES AND SALES IN THE UNITED STATES

As in the past, the principal purchases of supplies during the year were made by the Washington office. Branch offices in charge of assistant purchasing agents were continued at New York, New Orleans, and San Francisco. While these offices have not been called upon to make any purchases during the year, they have acted as receiving and forwarding agencies for materials which have been purchased through the Washington office for forwarding to the Isthmus through their respective ports.

The large majority of purchases are made for delivery on the Isthmus, in accordance with the long-established policy of permitting competition for the canal's requirements on even terms in all sections of the country. Inspection of materials has been continued, as heretofore, by a corps of inspectors in the field, assisted as occasion requires by officials of technical branches of the Government. The number of orders placed, 7,260, was 743 less than for the fiscal year

1930. The total value of orders placed during the year was \$3,763,-504.71, as compared with \$5,552,614.83 for the fiscal year 1930, a decrease of \$1,759,050.12 in value. Included in this total were requisitions for medical and hospital supplies handled, as in the past, by the Washington office, through the medical section, New York general depot, United States Army, Brooklyn.

In the assistant auditor's office 12,341 claims were handled and correspondence conducted relative thereto. This indicates a decrease over 1930 of 889 claims received, while there were examined and passed for payment 816 less than during the preceding year.

During the year 10,726 disbursement vouchers, amounting to \$4,821,085.15, and 577 collection vouchers, amounting to \$321,-583.91, were prepared. In addition to the collection vouchers 19 collections, amounting to \$40,168.31, were made by transfer of appropriations through the General Accounting Office, making the total amounts collected \$361,752.22 on 596 accounts. There was a decrease of 988 in the number of disbursement vouchers, with a decrease in disbursements of \$1,326,432.84 as compared with the last fiscal year. There was an increase of 50 in the number of collections, with a decrease of \$21,656.27 in the amount collected.

During the year 49 contracts were prepared, amounting to \$1,452,368.14. This is a decrease of 31 contracts and a decrease of \$1,147,723.19 in amount as compared with 1930.

In representing the Panama Canal in the United States, the Washington office handled extensive correspondence and maintained representation on various Government boards and coordinating committees, in addition to contacts with other Government departments and business interests with reference to canal activities.

HARBOR TERMINALS

The gross revenue from harbor terminal operations during the fiscal year amounted to \$1,456,570.55; the operating expenses were \$1,128,602.13, leaving a net revenue of \$327,968.42, as compared with \$331,937.45 last year, a decrease of \$3,969.03 for the year. There were 1,501,302 tons of cargo stevedored and transferred this year, as compared with 1,686,464 tons in 1930, a decrease of 185,162 tons for the year; 3,675 cargo ships and 1,284 banana schooners were handled, as compared with 3,801 and 995, respectively, in 1930. Agency service was furnished to 266 commercial vessels, as compared with 278 last year.

COMMISSARY DIVISION

The operations of the commissary division were continued along the same lines as in previous years, and the general organization remained the same. The policy of confining purchases to the United States was continued as far as practicable. Due to local conditions, and the fact that a large percentage of the employees are West Indian negroes, it is necessary for the commissary division to stock a certain quantity of foreign products for which these people express a definite preference. In addition to this, a great many foreign vessels transiting the canal and making purchases while en route demand certain well known and widely advertised commodities of foreign manufacture.

The greater portion of the fresh beef supply for the past year was purchased locally from cattle raisers in Panama who depend more or less on the canal as a market for their stock. One thousand nine hundred and eighty-one head of fat steers were purchased from cattle raisers in Cuba. This was a very fine lot of beef stock averaging 100 to 200 pounds per head heavier than the Panama native steers and when slaughtered yielded a considerably higher dressed weight percentage. It is not practical to import beef from the United States and sell it here at the prices which would necessarily have to be charged.

SALES

Every effort was made to restrict sales in the commissaries to individuals or organizations regularly entitled to buy in the stores. The majority of the infractions were of a more or less minor nature and promptly corrected. Total gross receipts from commissary sales and services during the year amounted to \$10,068,200.60 as compared with \$10,791,489.91 reported last year, a decrease of \$723,289.31 or 6.7 per cent. Sales to commercial vessels decreased more markedly than any other class of sales; the total in 1931 was \$789,365.78 which was less by \$309,605.34 than in 1930, the decrease being approximately 28 per cent. This was occasioned by reduced traffic, a tendency toward reduced purchases, and lower prices. Sales to Naval vessels, amounting to \$499,969, showed an increase of nearly 9 per cent, due to fleet concentrations at the Isthmus. Retail sales, principally to employees, showed a decrease of over 3 per cent, due primarily to a smaller force of employees and to reductions in prices.

The distribution of sales as compared with the two preceding years was as follows:

	1929	1930	1931
United States Government (Army and Navy).....	\$1,515,100.29	\$1,435,118.26	\$1,455,011.66
The Panama Canal.....	852,548.25	811,113.30	701,334.95
Commercial ships.....	1,134,886.75	1,098,971.12	789,365.78
Panama Railroad.....	287,390.17	372,686.30	299,818.15
Individuals and companies.....	713,041.23	693,724.76	685,067.17
Employees.....	6,431,718.85	6,820,568.75	6,546,485.93
Gross sales.....	10,934,685.54	11,232,182.49	10,477,083.64
Less discounts, credits, etc.....	455,114.33	440,692.58	408,883.04
Revenue from sales.....	10,479,571.21	10,791,489.91	10,068,200.60
Supplies for expenses:			
Retail commissaries and warehouses.....	43,467.34	49,123.67	47,912.84
General.....	1,669.27	4,152.68	4,376.65
Plants.....	33,515.51	30,579.70	32,796.89
Total.....	78,652.12	83,856.05	85,086.38
Loss by condemnation, pilferage, shrinkage, clerical errors, etc.....	188,043.15	249,754.72	215,794.35
Grand total.....	10,746,266.43	11,125,100.68	10,369,081.33

PURCHASES

Purchases during the year aggregated \$7,273,816.74, a decrease of \$920,903.62, or 12.5 per cent, as compared with the preceding year. The following tabulation shows the value of the various items purchased and the markets from which purchased as compared with the preceding years:

	1929	1930	1931
Groceries.....	\$1,688,256.48	\$1,690,265.72	\$1,548,080.12
Candies ¹	30,931.49	62,363.08	67,331.34
Tobacco.....	444,995.94	440,278.68	424,311.36
Hardware.....	494,128.65	494,546.27	535,034.71
Dry goods.....	1,262,837.68	1,378,259.34	1,096,416.14
Shoes.....	359,760.31	379,506.00	299,364.78
Cold storage.....	1,733,549.20	1,764,695.41	1,543,791.97
Toys.....	34,125.36	43,049.80	46,825.28
Stationery ²			47,717.63
Raw material.....	521,515.42	508,427.37	437,442.08
Cattle and hogs.....	538,486.59	601,400.36	640,918.70
Milk and cream.....	149,813.60	170,243.06	178,507.92
Eggs.....	254,327.01	318,811.26	201,109.50
Butter.....	303,233.36	166,747.96	195,428.96
Dressed beef.....	188,046.58	176,126.05	6,536.25
Total.....	8,004,007.67	8,194,720.36	7,273,816.74
PLACE OF PURCHASE			
United States.....	5,613,245.70	5,727,148.66	5,171,322.77
Europe and Orient.....	1,109,002.78	966,916.57	777,966.58
Central and South America.....	378,743.13	512,790.51	259,255.91
Cattle industry.....	620,837.40	696,071.26	750,313.47
Panama Canal.....	108,445.59	110,470.94	90,871.54
Local.....	173,733.07	181,322.42	224,086.47
Total.....	8,004,007.67	8,194,720.36	7,273,816.74

¹ Candies included in groceries prior to Jan. 1, 1929.

² Stationery included in dry goods prior to Aug. 1, 1930

MANUFACTURING PLANTS, ETC.

The output of the various manufacturing plants and laundry had a total value of \$2,317,052.72 as compared with \$2,318,030.55 for the preceding year, a decrease of \$977.83. The principal products of the major plants and their value are summarized as follows:

The output of the bakery included 5,461,573 loaves of bread, 2,175,602 rolls, and 381,347 pounds of soda crackers, together with cakes, pies, and doughnuts to the total value of \$324,628.30. The number of loaves of bread was greater than in any of the preceding 10 years.

The coffee roasting plant turned out 228,160 pounds of coffee, corn meal, peanuts, and almonds to the total value of \$83,509.97.

The principal output of the ice cream and milk-bottling plant consisted of 44,891 gallons of ice cream, 725,392 quarts of milk, and 26,237 quarts of cream with a combined value of \$252,887.37.

The ice manufactured during the year totaled 33,022 tons, valued at \$260,677.49.

The value of products manufactured in the industrial laboratory totaled \$251,945.45.

The abattoir turned out 4,987,116 pounds of dressed beef and by-products to the total value of \$640,918.70.

The number of pieces of laundry handled was 7,208,634 and receipts aggregated \$273,933.52.

HOTELS AND RESTAURANTS

The hotels Tivoli and Washington, at the two ends of the canal, are operated as essential adjuncts to afford suitable accommodations to persons having business to transact with the canal, foreign visitors, visiting officials, etc. Frequently during the dry season they are filled to capacity with tourists but this condition did not occur this year, passenger traffic having fallen off along with other business during the depression.

The cost of operating the Hotel Tivoli during the year was \$233,262.79, which was \$31,457.41 more than the revenue derived. The cost of operating the Washington was \$190,519.75, which was \$32,929 more than the revenue derived. Operating expenses at both hotels included increases in unexpended reserves. These were \$16,771.21 for the Tivoli and \$21,167.05 for the Washington, a total of \$37,938.26.

The restaurants and silver messes continued to be operated under contract during the year, with the exception of messes for both gold and silver employees in construction camps, etc.

BUILDING CONSTRUCTION AND MAINTENANCE

The principal projects of construction consisted of the following: Supply department storehouse and office building, Cristobal; silver commissary, Mount Hope; 45 new family quarters; 10 ordnance magazines for the United States Army; 1 barracks building for United States naval radio station, Balboa; 6 officers' quarters, 6 chief petty officers' quarters, 1 garage and storeroom for the United States Navy at Coco Solo and naval radio station at David, Republic of Panama. At the close of the year the following were the principal projects on which construction work was incomplete: New ward at Corozal hospital, electric storehouse at Balboa, construction of main building at Gamboa penitentiary, storehouse for spare miter lock gates, 28 family quarters at Cristobal, and 11 family quarters at Balboa.

Maintenance of existing structures was continued as heretofore.

Plans outlined for 1932 include the commencement of construction of new high school at Cristobal, elementary school at La Boca, nurses' quarters at Colon Hospital, and fire stations at Pedro Miguel and Gatun.

The following family quarters for American employees, for which funds were provided by the Panama Railroad Co., were under construction at the end of the fiscal year: At Cristobal, 3 official, type-106 houses, 3 apartments; 12 type-103 houses, 24 apartments; 2 type-104 houses, 4 apartments; and 11 type-101 houses, 11 apartments; at Balboa, 11 type-103 houses, 22 apartments, and one converted 2-story 2-family house, 2 apartments.

QUARTERS FOR EMPLOYEES**GOLD EMPLOYEES**

The family quarters situation for the entire Zone is easier at present than it has been for several years due to the completion of new quarters under the 1931 building program which provided quarters for the majority of applicants. Practically all gold family apartments authorized for 1932 and 1933 will be in the nature of replacement of old quarters which are of no further service and beyond economical repair. With the completion of the 40 family apartments now under construction at Cristobal, there will be left for future replacement 110 apartments. A similar condition exists at Gatun where it will be necessary to replace some 50 family houses and 2 bachelor houses during the next two or three years. In the Ancon-Balboa district there are approximately 376 family and 450 bachelor apartments and in Pedro Miguel district approximately 143 family and 60 bachelor apartments which should be replaced as soon as funds can be made available.

At the close of the fiscal year there were 44 applications on file for family quarters, distributed as follows: Ancon-Balboa district, 27; Cristobal district, 6; Pedro Miguel, 9; and Gatun, 2. New houses under construction at Balboa will provide 24 additional family apartments in the near future which will reduce the waiting list accordingly. All quarters were maintained in as good condition as available funds would permit. A considerable number of old frame quarters were disposed of by sale, after advertising, to make room for new houses on the same sites, but there are still several of these which should be abandoned. Maintenance expenses on such buildings are kept down to the absolute minimum.

During the year 41 houses or 70 family apartments were constructed and occupied at Balboa and 4 houses or 4 apartments at Cristobal.

SILVER EMPLOYEES

The demand for silver quarters is still far in excess of the supply. At the close of the fiscal year there were 1,801 applications for silver family quarters on file in all districts, distributed as follows: Ancon-Balboa, 910; Pedro Miguel, 126; Cristobal, 730; and Gatun, 35. Over 50 per cent of the silver employees are required to live in Panama and Colon where rental rates are considerably higher than charged by the canal for quarters in the Canal Zone. Construction of additional quarters for these employees should be continued to enable them to live near their work and place them on a more economical basis. The cost of operation and maintenance of silver quarters exceeded the rents collected.

LANDS AND BUILDINGS

Panama Railroad lands in the cities of Panama and Colon and public lands in the Canal Zone are administered by a joint land office.

PANAMA RAILROAD CO. LANDS AND LEASES

During the fiscal year 80.49 square meters of Panama Railroad land in the city of Panama were sold for \$2,414.70, making a total revenue from land sales since the Panama Railroad Co. adopted the policy of selling its real estate holdings of \$690,485.44.

There were in effect at the close of the fiscal year 1,456 leases and 14 licenses covering the use of Panama Railroad properties in the cities of Colon and Panama. The income derived from these during the fiscal year was \$322,978.54. This represents an increase in revenue over the year 1929-1930 of \$48,584.76 which was due to the issuance of five new leases and to the increased rentals charged on lease renewals, as a considerable number of leases expired during the year and were renewed at increased rentals.

All of the improved property of the Panama Railroad in Panama and Colon is now held under lease. Many new buildings were erected during the year by lessees of lands previously not occupied by improvements, and a considerable number of old wooden buildings have been demolished and replaced by modern buildings of fire-proof construction.

LICENSED AGRICULTURAL LANDS IN THE CANAL ZONE

A total of 1,927 licenses, covering 4,916 hectares (12,147.93 acres) of agricultural land in the Canal Zone, were in effect on June 30, 1931. The rental collected for licenses on these lands aggregated \$26,886.35. This is a reduction in the number of licenses over the fiscal year 1929-30 of 175, and a reduction of the area held under license of 886 hectares (2,189.39 acres). The average holding under these licenses was 2.55 hectares (6.30 acres) per license.

The gross income from all real estate operations handled by the land office during the fiscal year was \$402,009.59, made up as follows: Rentals on property in the cities of Colon and Panama, \$322,288.54; rental of agricultural lands in the Canal Zone, \$26,886.35; rentals of building sites and oil tank sites, \$50,420; sale of property in the city of Panama, \$2,414.70.

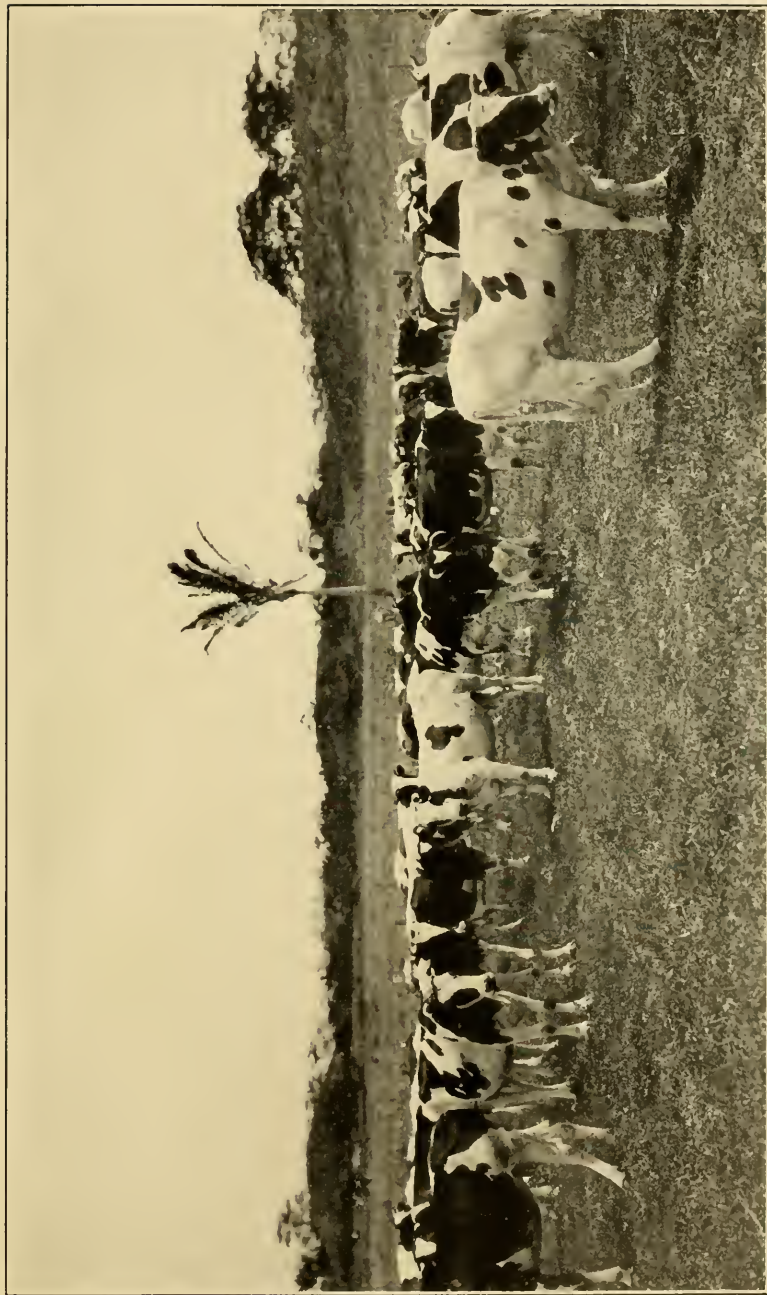
MOTOR AND ANIMAL TRANSPORTATION

Motor and animal transportation for all departments and divisions continued to be supplied by the transportation division under the pool system. The division is charged with the operation and maintenance of all transportation equipment and is required to operate upon a self-sustaining basis. There was a considerable decrease in hauling operations with the completion of the Madden Road, but with the resumption of work on the Thatcher Highway during the dry season of 1931-32, a temporary increase is expected.

Eighty-four cars and trucks were purchased and 77 were retired during the year. Equipment on hand at the close of the year consisted of 326 cars and trucks, 6 trailers, 16 motor cycles, 9 mowing machines, and 10 mules. Revenues exceeded expenditures for the fiscal year by \$12,027.97, as compared with an excess of \$53,372.33 for the preceding year.

PANAMA CANAL PRESS

The printing plant carries in stock and manufactures such necessary stationery, forms, etc., as are required on the Isthmus in connection with the canal and Panama Railroad operations. It is the established policy to curtail all classes of printing work as much as possible so as to avoid the printing of excessive quantities of any item, and to keep the working force and inventory stock down to the minimum. The



MINDI DAIRY HERD OF PUREBRED HOLSTEINS

manufacturing output for the fiscal year amounted to \$170,386.47 as compared with \$189,834.25 for the previous year, a decrease of \$19,447.78. The inventory value of material on hand at the end of the year was \$79,605.30. Three automatic presses and one automatic ruling machine were installed during the year by way of replacements.

FARM INDUSTRIES

PLANTATIONS

All plantations continued to be operated under contract under the same general conditions as for previous years.

DAIRY FARM

The operation of the dairy farm continued along the same lines as for the previous years, and milk production exceeded that of any other year since its inception. The total milk production was 148,059 gallons, a gain of 12,891 gallons over last year. The health department dairy at Corozal was closed down during the year and 54 head of the stock from that dairy were taken over by the supply department. One hundred head of grade Jersey dairy cows and 15 head of purebred Holstein heifers were purchased in the United States and added to the herd during the year. Five purebred Holstein bulls were sold during the year to private parties. At the close of the fiscal year the herd numbered 634, including 76 bulls and calves, as compared with 515, including 140 bulls and calves, at the close of the previous fiscal year.

CATTLE

At the beginning of the fiscal year the cattle in pastures numbered 356 head. As stated in last annual report the use of pastures has been abandoned to a large extent and the practice adopted of purchasing fat cattle for slaughter shortly after delivery. During the year 1,981 head of fat cattle were purchased in Cuba and 7,388 in Panama. Contract was entered into on June 24, 1931, for the purchase of 5,000 head of fat cattle from Alfredo Infante, of Holguin, Cuba, for delivery between September 1, 1931, and September 1, 1932.

Deaths from stock during the year were 34 fat cattle, 8 breeding stock, and 34 dairy stock.

EXPERIMENTAL GARDENS

These gardens continue to grow more deeply into the life of the community. The purposes are coming to be more clearly understood in the introduction, testing, establishing and disseminating of valuable plants; in the conducting of experimental work with plants and in fostering plant life in every way possible as a factor in community

betterment and development. To this end the gardens maintain exchanges of seeds and plants with botanic gardens, agricultural departments, experiment stations and individuals in many parts of the tropics and subtropics. The number of local visitors is increasing and each year brings a larger quota of visitors from abroad. Each year witnesses the coming to maturity of some plants not seen before in this part of the world. Since water is now being made available for use during the dry season, many plants that have been awaiting opportunity are now being set out. The inflow of new introductions that are expected to be of value is maintained by exchanges through correspondence and by a policy of active personal collection in foreign countries as opportunity offers.

PLANTS OF THE YEAR

Among the plants that have become sufficiently established to attract special attention during the year are:

Mangosteen (Garcinia mangostana).—This is one of the most highly prized fruits of the Oriental tropics, and is native of Malay and the East Indies. It was introduced into the Isthmus by Dr. David Fairchild, then chief of the office of foreign plant introduction of the United States Department of Agriculture. Two or three of the first trees were planted at Frijoles and have produced some fruit for several years. The progress of those at the experiment gardens has been watched with deep interest. The trees have made excellent growth, and, while only 6 years old, several have yielded a few fine fruits. This is considered rather precocious for mangosteen trees and, together with their vigorous, healthy, and undisturbed growth, gives much promise for the future.

Hawaiian cooking bananas.—This cooking banana, as it is commonly called in Hawaii, is like the plantain in its culinary uses but entirely different in appearance and quality. There are several varieties of these, some of the more important being classed as the Maoli group. Three or four varieties of this group were introduced from Hawaii early in 1929 and some of these have fruited. If permitted to become thoroughly ripe, even to the degree of the blackening of the skin, this variety when baked is a most delicious food used either as a vegetable, like baked plantain, or with cream and sugar as a dessert fruit.

Pineapple, variety Cayenne (Hawaiian).—In the latter part of October, 1929, about 3,000 slips and suckers of Cayenne pineapple were received from Hawaii. This is the variety upon which the Hawaiian pineapple-canning industry is founded and because of the leading place which Hawaii has taken in pineapple canning and the prominence which it has given this pineapple, the variety is often spoken of as Hawaiian. The recognized name, however, is Cayenne.

The plants were set out promptly when received, which was less than two months before the end of the wet season, hence they had only two months of good growing weather before they were overtaken by the dry season. No irrigation water was applied. Nevertheless the plants made good growth and began to ripen fruit in June, 1931, 20 months after planting. This result is about the same as that experienced from October plantings in Hawaii. In flavor, texture, and general appearance the Cayenne pineapples grown at Summit do not appear to be inferior in any way to the high standards of excellence that have been attained in Hawaii. It will be possible to disseminate a considerable number of plants during the coming year.

Solo papaya.—This papaya, another introduction from Hawaii, has been found to be superior in flavor and texture to any other papaya so far introduced.

Sugarcanes.—Several of the many varieties of sugarcanes that have been introduced and held under test have proven to be very promising for this region and are being disseminated for trial under plantation conditions.

TELEPHONES AND TELEGRAPHS

The gross revenue from the operation of telephones, electric clocks, and electric-printing telegraph machines amounted to \$246,053.48 and the total expenses were \$199,858.77, leaving a net revenue of \$46,194.71, as compared with \$39,342.41 for the preceding year, an increase of \$6,852.30 for the year.

During the year, 1,218 telephones were installed and 1,155 removed, making a net increase of 63 telephones for the year. At the end of the year the total number of telephones installed numbered 2,999 as compared with 2,936 for the preceding year. A total of 22 automatic typewriters, or electric printing telegraphs, were in use at the end of the year; 14 are in use by the Panama Canal departments, 2 by the Panamanian Government, and 6 by commercial enterprises. Electric clocks in service numbered 74.

The principal telephone change during the year was the replacement of the worn out and inadequate manually operated system at Gorgas Hospital by dial phones as a part of the automatic system. The shift to the new system was made on November 16, 1930.

OPERATIONS WITH PANAMA RAILROAD FUNDS

Many of the business activities on the Isthmus connected with the operation of the canal are conducted with funds of the Panama Railroad Co. Included in these are the wharves and piers at the harbor terminals, the commissary system, coaling plants, hotels, and various minor activities, as well as the Panama Railroad itself. In this report only the major features of these operations are noted in

their relation to the canal administration as a whole. Details are given in the annual report of the Panama Railroad Co., which is published separately.

The operations of the railroad proper, harbor terminals, coaling plants, stables, and baggage transfer were continued throughout the year under the direction of the superintendent of the railroad; the telephone system under the electrical engineer of the Panama Canal; renting of lands and buildings under the land agent; and the commissaries, hotels Washington and Tivoli, plantations, dairy farm, and cattle industry under the chief quartermaster of the Panama Canal.

PANAMA RAILROAD CO.

The gross revenues during the fiscal year 1931 from the operations of the Panama Railroad proper (not including subsidiary business activities) amounted to \$1,685,607.81; the gross operating expenses were \$1,528,555.62, resulting in a net revenue of \$157,052.19, as compared with \$302,355.73 last year, a decrease of \$145,303.54 for the year.

Tonnage of revenue freight transported during the year aggregated 323,476 tons, as compared with 441,461 tons during 1930, a decrease of 117,985.

Statistics covering various features of the railroad operations during the past three years are presented in the following table:

	1929	1930	1931
Average miles operated, Colon to Panama.....	47.61	47.61	47.61
Gross operating revenue.....	\$1,832,260.67	\$1,766,478.92	\$1,685,607.81
Operating expenses.....	\$1,493,591.95	\$1,464,123.19	\$1,528,555.62
Net operating revenue.....	\$338,668.72	\$302,355.73	\$157,052.19
Per cent of expense to revenue.....	81.51	82.88	90.68
Gross revenue per mile of road.....	\$38,484.79	\$37,103.11	\$35,404.49
Operating expenses per mile of road.....	\$31,371.39	\$30,752.43	\$32,105.77
Net revenue per mile of road.....	\$7,113.40	\$6,350.68	\$3,298.72
Number of passengers carried:			
First class.....	208,503	210,024	200,559
Second class.....	437,379	392,818	293,687
Total.....	645,882	602,842	494,246
Revenue per passenger train-mile.....	\$4.24	\$4.89	\$4.77
Revenue per freight train-mile.....	\$11.47	\$10.92	\$11.18
Total revenue train mileage.....	201,774	205,770	196,651
Railroad revenue per train-mile.....	\$9.08	\$8.58	\$8.57
Railroad operating expenses per revenue train-mile.....	\$7.40	\$7.12	\$7.77
Net railroad revenue per revenue train-mile.....	\$1.68	\$1.47	\$0.80
Freight, passenger, and switch locomotive mileage.....	332,419	338,401	323,501
Work-train mileage.....	¹ 12,343	5,990	¹ 10,394
Passenger-train mileage.....	112,488	114,668	111,718
Freight-train mileage.....	89,286	91,102	84,933

¹ Overhaul of locks occurred in these years.

CANAL ZONE FOR ORDERS

As an aid to the distribution of goods to areas served by steamship lines using the Panama Canal or its terminal ports, there was established, under a circular issued March 17, 1925, the arrangement known

as Canal Zone for orders. Under this system merchandise is shipped to Canal Zone ports (Cristobal or Balboa) to be held there in warehouses of the Panama Railroad Co. for orders. Such cargo, or integral parts of it may be withdrawn and delivered locally or forwarded as the consignor or consignee may desire, except that goods for use in the Canal Zone or the Republic of Panama, by others than those entitled to the free-entry privileges, are released only upon the presentation of satisfactory evidence of the payment of the proper duty to the Republic of Panama. Many different commodities were handled in this way during the year, and the total of cargo received under the arrangement was 24,200 tons. This was a decrease of about 37 per cent from the tonnage received during the preceding year. The number of packages received decreased approximately 29 per cent, but the total receipts issued for cargo increased about 22 per cent. The total business for the past three years is summarized in the following table, with the 1931 activities also shown by each of the terminal ports:

	1929	1930	1931		
			Cristobal	Balboa	Total
Number of receipts issued.....	1,303	1,495	1,431	482	1,913
Number of withdrawals.....	8,359	10,053	8,571	2,889	11,460
Tons received.....	39,533	38,136	19,502	4,698	24,200
Tons withdrawn.....	33,060	36,799	19,911	4,317	24,228
Packages received.....	146,701	169,520	83,619	36,636	120,255
Packages withdrawn.....	133,783	156,366	83,589	37,994	121,583

PANAMA RAILROAD STEAMSHIP LINE

The gross operating revenue of the steamship line for the fiscal year ended June 30, 1931, amounted to \$1,518,483.49, and the gross operating expenses amounted to \$1,763,179.42, resulting in a net deficit from operations of \$244,695.93. The operating deficit compared with the net loss for the fiscal year ended June 30, 1930, of \$152,967.82, shows a decrease in the net revenue of \$91,728.11.

For the year ended June 30, 1931, the tonnage carried by the steamship line amounted to 163,464 tons, as compared with 217,263 tons for the previous year; a decrease of 53,799 tons.

The steamship line carried freight and passengers for account of the Panama Canal and other departments of the Government of the United States at material reductions from tariff rates, which amounted to the important sum of \$505,980.76. Had regular tariff rates been received by the steamship line for such freight and passenger service performed for the Panama Canal and other Government departments, its operations for the year would have resulted in a profit of \$261,284.83.

SECTION III

ADMINISTRATION

The organization of the Panama Canal on the Isthmus embraces five principal departments, namely, operation and maintenance, supply, accounting, executive, and health.

DEPARTMENTS

OPERATION AND MAINTENANCE

The department of operation and maintenance embraces functions related to the actual use of the canal as a waterway, including the dredged channel, locks, and aids to navigation; and accessory activities, such as shops and dry docks, vessel inspection, electrical and water supply, sewer systems, roads and streets, hydrographic observations, surveys and estimates, and miscellaneous construction, other than the erection of buildings.

SUPPLY

The supply department is charged with the accumulation, storage, and distribution of materials and supplies for the canal and Panama Railroad; the operation of commissaries, hotels, cattle pastures, dairy and experiment gardens; the maintenance and construction of buildings; the assignment of quarters and care of grounds; and the sale of provisions and other supplies, except coal and water, to ships. It also operates corrals and motor transportation, manufacturing plants, bakeries, ice plants, abattoirs, printing plant, and other related activities.

ACCOUNTING

The accounting department is responsible for the correct recording of financial transactions of the canal and railroad, the administrative auditing of vouchers covering the receipt and disbursement of funds preliminary to the final audit by the General Accounting Office, cost keeping of the canal and railroad, the checking of timekeeping, the preparation of estimates for appropriations and the allotment of appropriations to the various departments and divisions, and the examination of claims. The collector and paymaster are attached to the accounting department.

EXECUTIVE

The executive department embraces the general office business of the governor, administrative activities invested by Executive order within the authority of the executive secretary, and for purposes of administration of material business needs only, the courts, marshal of the Canal Zone, and office of the district attorney. Under this department come the administration of police and fire protection,

postal service, customs, shipping-commissioner work, estates, schools, general correspondence, and records for the organization of the canal and the Panama Railroad, personnel records, time keeping, wage adjustments, statistics of navigation, information and publicity, relations with Panama and the operation of clubs and playgrounds.

HEALTH

The health department is charged with all sanitary matters within the Canal Zone and the cities of Panama and Colon, the operation of the hospitals and dispensaries, the enforcement of quarantine regulations, and the compilation of vital statistics in the Canal Zone and in the cities of Panama and Colon.

The operations of the Panama Railroad Co. on the Isthmus are generally related closely to the work of the canal, and the railroad organization is in effect a part of the canal organization. The governor is president of the Panama Railroad; the heads of departments in the canal organization and of the railroad report to him. The general administration of the composite organization is centered in the executive office, and the accounting work in the accounting department; the Panama Railroad and other divisions of the general organization are billed for their proper share of the general overhead work.

CHANGES IN ORGANIZATION AND PERSONNEL

There were no changes in the organization during the fiscal year. The few changes in supervisory personnel are covered in the following paragraphs:

Capt. C. H. Woodward, United States Navy, was relieved from duty as marine superintendent on June 6, 1931, having finished his tour of duty. His successor, Capt. William Ancrum, United States Navy, had not reported for duty at the end of the year.

Commander Guy C. Barnes, United States Navy, was appointed captain of the port, Balboa, July 4, 1930, vice Commander S. A. Taffinder, United States Navy, relieved from duty with the Panama Canal.

Dr. Paul Preble, United States Public Health Service, health officer of Panama City, died on July 13, 1930. Dr. J. L. Byrd was transferred to the position from his previous position of health officer of Cristobal-Colon, and Dr. D. G. Sampson was transferred from his previous position of district physician at Pedro Miguel to be health officer of Cristobal-Colon, temporarily, effective November 1, 1930.

Mr. J. J. McGuigan was appointed district attorney, effective October 23, 1930, vice Mr. C. J. Riley, who had resigned on April 15, 1930.

Mr. H. A. A. Smith was appointed assistant auditor in the Washington office, effective October 23, 1930, vice Mr. Noble Moore, who died on October 7, 1930.

FORCE EMPLOYED

The supervisory, technical, higher clerical, and highly skilled mechanical employees, consisting primarily of American citizens but including a few others, are employed on what is known as the gold roll; the rest of the force, principally aliens but including a few American citizens on low-paid work, are designated silver employees. These terms are a heritage from the tropical practice of paying Americans and Europeans in gold because of its stability, while the native or tropical labor was paid in the local currency, based on silver.

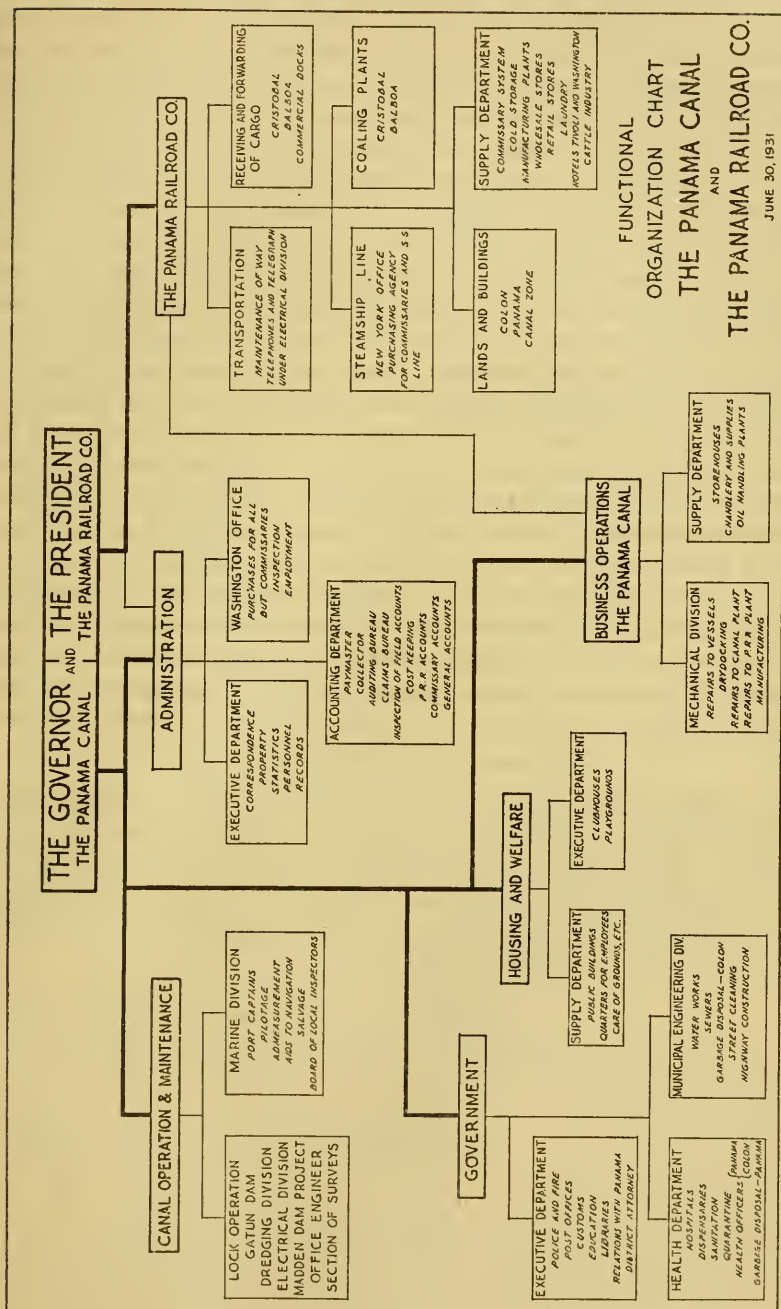
Based on the last force reports in June of each year, the gold force decreased from 3,344 as of June, 1930, to 3,276 in June, 1931, a decrease of 68, or 2.03 per cent. The silver force decreased from 11,780 to 10,624, a decrease of 1,156 or 9.81 per cent. The combined force decreased from 15,124 to 13,900, a decrease of 1,224 or 8.09 per cent. The force report shows all gold employees in service on the date of the report, including those on leave, but not including the few who, newly employed in the United States, are in transit to the Isthmus at the time of the report. For silver employees, the force report shows only those who worked on the day of the report.

GOLD EMPLOYEES

The distribution of the gold personnel near the ends of the two fiscal years is shown in the following tabulations:

Department or division	Gold force		Decrease	Increase	Net decrease
	June 18, 1930	June 17, 1931			
Operation and maintenance:					
Office.....	55	55			
Electrical division.....	158	170		12	
Municipal engineering division.....	88	89		1	
Lock operation.....	239	236	3		
Dredging division.....	198	194	4		
Madden Dam project.....	50	26	24		
Mechanical division.....	504	475	29		
Marine division.....	203	196	7		
Fortifications.....	24	18	6		
Total, operation and maintenance.....	1,519	1,459	73	13	60
Supply department:					
Quartermaster.....	225	203	22		
Commissary division.....	228	249		21	
Cattle industry.....	2	2			
Hotel Tivoli.....	8	8			
Hotel Washington.....	9	9			
Transportation.....	74	72	2		
Total, Supply department.....	546	543	24	21	3
Accounting department.....	204	206		2	
Health department.....	293	290	3		
Executive department.....	537	553		16	
Total, three departments.....	1,034	1,049	3	18	¹ 15
Panama Railroad:					
Superintendent.....	50	44	6		
Transportation.....	64	61	3		
Receiving and forwarding agency.....	88	78	10		
Coaling stations.....	43	42	1		
Total, Panama Railroad.....	245	225	20		20
Grand total.....	3,344	3,276	120	52	68

¹ Increase.



FUNCTIONAL ORGANIZATION CHART, THE PANAMA CANAL AND PANAMA RAILROAD CO., JUNE 30, 1931

The decreases in force were due essentially to completion of parts of the work or to lessened activities in other branches. The increases, occurring in 5 of the 22 units of the organization, were due to the following causes: Electrical Division increase was caused by the unusual amount of work performed on United States Navy submarines, consisting of the installation of electrical safety devices, which necessitated the employment of two shifts on this work throughout the year; and to moving the Summit substation and beginning the transmission line work incidental to the Madden Dam project. The municipal division increase of one man is attributed to the construction of the Thatcher Highway; near the middle of the fiscal year the division's force was greater than at either the beginning or the ending. The increase of 21 in the gold force of the commissary division was due to the employment of a commissary manager at the new Silver City commissary, additional employment of two apprentice meat cutters, one checker, one clerk and one sales clerk, and the filling of vacant positions, principally of six foremen and eight sales clerks to speed up the service, and that of buyer for the wholesale dry-goods section. The accounting department added a new position of accountant and three positions of operatives, but these increases were offset by reducing elsewhere, making the net increase of gold force two. The increase in the executive department was due to seven new positions in the schools, two new positions of clerk, one new position of aeronautical inspector and one of customs guard, and the filling of several vacancies, including the position of district attorney.

RECRUITING AND TURNOVER OF FORCE

The following table shows additions to the gold force and separations from it in the fiscal year from July 1, 1930, to June 30, 1931, inclusive. Employments are classified as made in the United States or on the Isthmus and separations are classified by cause. This table covers a slightly different period from that between the force reports of June 18, 1930, and June 17, 1931:

	Operation and main- tenance	Execu- tive	Supply	Health	Account- ing	Panama Railroad	Totals
Employed or reemployed in United States.....	65	32	2	29	1	1	130
Employed or reemployed on Isthmus.....	103	33	20	26	11	44	237
Total additions.....	168	65	22	55	12	45	367
Resigned.....	53	23	12	51	4	21	164
Retired.....	16	3	3	1	2	5	30
Died.....	9	3	1	2	-----	4	19
Reduction of force.....	37	-----	7	2	-----	2	48
Expiration of temporary employment.....	102	6	15	6	2	13	144
Discharged for cause.....	10	3	-----	2	2	1	18
Insane.....	1	-----	-----	-----	-----	-----	1
Disability.....	7	-----	-----	1	1	4	13
Failure to report back from leave.....	-----	-----	-----	1	-----	-----	1
Transferred to silver roll.....	-----	-----	3	-----	-----	-----	3
Total separations.....	235	38	41	66	11	50	441
Separations, Panama Canal.....	391	Separations, Panama Railroad.....					50
Additions, Panama Canal.....	322	Additions, Panama Railroad.....					45
Net separations.....	69	Net separations.....					5

The number of persons tendered employment through the Washington office of the Panama Canal, all above the grade of laborer, during the fiscal year was 255, of whom 145 accepted and were appointed, covering 30 different kinds of positions. Acceptances and appointments were 64.4 per cent of the tenders. In the preceding year the tenders numbered 455, acceptances and appointments 217, and the latter were 47.7 per cent of the tenders.

The number of persons added to the rolls on the Isthmus during the fiscal year by employment or reemployment in the United States on requisitions is reported by the personnel bureau as 130. The variation from the figures reported by the Washington office is attributed to some appointments made without requisitions and to difference in time between acceptance and actual entry on the rolls. Counting 130 as the employments or reemployments actually entered on the rolls and 237 as those employed or reemployed on the Isthmus, the total additions were 367. The separations from the gold roll during the year totaled 441, making a net decrease of 74.

Based on a gold force of 3,331 at the beginning of the fiscal year, as shown on the force report for July 2, 1930, the 441 separations make a turnover rate of 13.2 per cent for the year, from all causes. For the fiscal year 1930 the rate was 15.4 per cent.

When an additional employee is needed efforts are made to fill the position by promotion from the force already employed or by transfer to it of an employee whose work in another department is about to terminate. This tends to reduce employment of people unused to Canal Zone conditions, to reduce recruiting costs, and to give the organization the benefit of the employee's accrued experience in local conditions. It has a further value in strengthening the morale of the force through giving the employees a reasonable expectation of continued employment as long as their services are satisfactory, which builds up loyalty to the Canal. Of the 367 gold-roll employments during the past year, approximately 42 per cent were reemployments; 109 were reemployed on the Isthmus and 45 in the United States.

At the end of the year the applications on file from residents of the Isthmus for employment on the gold roll numbered approximately 600.

Three thousand and twenty-eight persons (2,794 from New York, 121 from New Orleans and 113 from Pacific coast ports), including new appointees, employees returning from leaves of absence, and members of their families, were provided transportation from the United States to the Isthmus. The total was an increase of 248 over the previous year's total.

SILVER EMPLOYEES

The distribution of the silver personnel near the ends of the two fiscal years is shown in the following tabulation:

Department or division	June 18, 1930	June 17, 1931	Decrease	Increase	Net de- crease
Operation and maintenance:					
Office.....	85	49	36		
Electrical division.....	177	205		28	
Municipal engineering division.....	674	771		97	
Lock operation.....	702	682	20		
Dredging division.....	981	931	50		
Madden Dam project.....	619	237	382		
Mechanical division.....	884	908		24	
Marine division.....	596	564	32		
Fortifications.....	141	56	85		
Total, operation and maintenance.....	4,859	4,403	605	149	456
Supply department:					
Quartermaster.....	1,978	1,650	328		
Commissary division.....	1,324	1,305	19		
Cattle industry.....	98	89	9		
Hotel Tivoli.....	108	103	5		
Hotel Washington.....	95	92	3		
Transportation.....	251	228	23		
Total, supply department.....	3,854	3,467	387		387
Accounting department.....	6	6			
Health department.....	862	822	40		
Executive department.....	328	333		5	
Total, three departments.....	1,196	1,161	40	5	35
Panama Railroad:					
Superintendent.....	252	235	17		
Transportation.....	124	116	8		
Receiving and forwarding agency.....	1,289	1,074	215		
Coaling stations.....	206	168	38		
Total, Panama Railroad.....	1,871	1,593	278		278
Grand total.....	11,780	10,624	1,310	154	1,156

The silver force, performing lower-paid work, is more variable than the gold force of supervisory and other more highly paid employment, and detailed figures as to employments and separations on the silver roll are not available. In general, decreases were due to curtailment of work, and the increases to more or less temporary fluctuations.

No serious difficulty was experienced in maintaining an adequate force, and the percentage of turnover was low for this class of labor. At the end of the year there was a surplus of labor available for practically all kinds of work performed by silver employees, and extensive unemployment.

WAGE ADJUSTMENTS

GOLD EMPLOYEES

The Panama Canal act provides that salaries or compensation fixed thereunder by the President, or by his authority, "shall in no instance exceed by more than 25 per cent the salary or compensation paid for the same or similar services to persons employed by the Government

in continental United States." Concurrently with this limitation it has been the policy to pay generally to United States citizens employed on the gold roll the full 25 per cent above pay for similar work in the United States, within the limitations of appropriations and subject to the preservation of coordination within the organization.

The work of bringing the grades of employees coming under the classification act of 1923, as amended by the Welch Act of 1928 and the Brookhart Act of 1930, into conformity with the class specifications issued by the Personnel Classification Board in Washington, was practically completed. Revised lists of positions with their allocations were issued as of December 1, 1930, and allocations so designated have remained in effect. The automatic increases under the Brookhart Act were made effective July 3, 1930. An adjustment of rates for employees carried in positions designated as subclerical and not coming within the classification schedules was made effective October 1, 1930.

An adjustment of rates of pay of employees on floating equipment, including pipe-line and dipper dredges, towboats, floating cranes and craneboat, hydraulic grader, drill boats, supply boats, and certain types of motor boats, which had been under discussion from the preceding fiscal year, was terminated by a decision of the governor on October 29, 1930. This established the rate of pay for master of 20-inch pipe line suction dredge directly on the basis of the pay for such service under the Corps of Engineers of the Army in the United States, and fixed for other positions in the canal service on the designated vessels a schedule of rates in coordination with the rate for master of 20-inch suction dredge. The basic reason for doing this is the difficulty in determining equitable rates for equipment for which there is no prototype in Government service in the United States, and in preserving coordinate pay among related positions by any other means than an adjudication of their relative requirements, responsibility, etc., under the conditions on the Isthmus.

The wage board, consisting of the assistant engineer of maintenance and a representative selected by the organizations of employees and approved by the governor, held 10 meetings during the year.

The salary board, composed of the heads of the nine major departments and divisions of the Panama Canal and Panama Railroad, held three meetings during the year in connection with the adjustment of rates for classified positions referred to above and various matters of rates and working conditions. Both the wage and salary boards are merely advisory to the governor, who is charged with the fixing of all rates of pay.

ALIEN EMPLOYEES ON THE SILVER ROLL

The silver wage board, consisting of the heads of 13 departments and divisions of the Panama Canal and Panama Railroad, held meetings in November and May. As with the boards on gold rates of pay, this board acts in an advisory capacity to the governor.

The basic rate of 20 cents per hour for unskilled labor, with the proviso that 21 or 22 cents may be used as the entrance rate, remained in effect during the year. There was no considerable change in the schedule of rates of pay, though a few changes were authorized for designated crafts.

The average rates paid to alien employees as of October 1, 1930, when the annual general survey was made, as compared with preceding years, were as follows:

	Average rates			Average rates	
	Monthly employees (per month)	Hourly employees (per hour)		Monthly employees (per month)	Hourly employees (per hour)
Nov. 1, 1923.....	\$55.27	\$0.2312	Oct. 1, 1927.....	\$54.88	\$0.2411
Nov. 1, 1924.....	54.74	.2323	Oct. 1, 1928.....	56.44	.2496
Nov. 1, 1925.....	55.28	.2385	Oct. 1, 1929.....	55.37	.2450
Nov. 1, 1926.....	55.40	.2395	Oct. 1, 1930.....	57.09	.2560

The average rate per month, combining the monthly rates with the hourly rates on the basis of 208 hours of working time per month, was \$55.13 for a total of 11,472 positions. At the time of the preceding annual survey this average was \$52.83 for 12,976 positions, and for the survey of October, 1928, it was \$54.18 for 11,210 positions.

The average pay of the silver employee tends to fall with increases of force. Individuals of long employment and satisfactory service advance to the top of the pay schedule of the craft, and are more likely to be retained when reductions of force occur. New employees enter service at the lower rates. However, the variations in averages are not wide. The difference between maximum and minimum averages for monthly employees as tabulated above for 8 annual surveys is \$2.35, or 4.29 per cent of the minimum. For the hourly rates, the difference is 2.48 cents, or 10.73 per cent.

Following the rise in the cost of living after the outbreak of the World War in 1914, the schedule of silver rates of pay was adjusted from time to time with reference to the rise, and subsequent fall, of an index based principally on weighted prices in the commissary stores, with those in July, 1914, as 100. The last decrease in the schedule of rates of pay was made on July 1, 1922, following the drop of the index from 155.46 as of April 1, 1922, to 150.04 for July. Computation of the index has, however, been continued for each

regular semiannual meeting of the silver wage board as a matter of information. With reference to the foregoing tabulation, showing average rates from November 1, 1923, to October 1, 1930, it is noted that the index has lowered from 148.69 as of October 1, 1923, to 137.90 as of June 1, 1930, and 125.69 as of June 1, 1931. This index lowered 12.21 points during the past fiscal year.

On recommendation of the silver wage board at its meeting in November, 1930, the "average rule" affecting promotions was abolished. This rule had been that if the range of pay between minimum and maximum in the schedule for the craft was \$15 or more, the average paid by the department or division should not be higher than the figure determined by subtracting \$7.50 from the maximum rate in the schedule for the craft, but where the range was less than \$15 no such restriction would be imposed. Corresponding provisions were made for the hourly roll and promotions were allowed in exceptional cases. The purpose of the rule was to provide approximately equal pay throughout the organization for similar services. The majority of heads of departments, however, regarded it as interfering with the best administration and the rule was dropped.

The board discussed at both semiannual meetings the matter of rest or vacation leave for silver employees, and considered data relative to the subject collected from American consuls and various employers in the Caribbean area. The recommendation of the board was that no rest leave be granted for silver employees under present conditions. Sick leave was already in effect.

The committee on superannuated alien employees, appointed on January 8, 1929, continued to function throughout the year. During the year this committee held seven meetings, two of which were for consideration of plans to obtain extension to Panama Canal employees of the plan of pensioning followed for the Panama Railroad alien employees. During the year there were 15 additions to the Panama Railroad pension roll and 18 separations, leaving 31 pensioners on the roll at the end of the year; 2 others were given lumps sums and repatriated during the early part of the year. Twelve Panama Canal alien employees were placed on reduced rates, established in the fiscal year 1930 by supplement No. 4 to the schedule of silver rates of pay for superannuated aliens unable to perform in a reasonably satisfactory manner the usual service expected of an able-bodied employee. Others were given or offered domiciliary care at Corozal Hospital.

COMPLAINTS BOARD

The complaints board is for the purpose of investigating and reporting on complaints of employees about working conditions and administrative actions, etc., referred to it by the governor. It is composed of the assistant engineer of maintenance, the head of the

department or division in which the specific complaint originates, and two representatives of the employees who are nominated by the central body of the employees' associations and approved by the governor. One case was handled by this board, as compared with two in the fiscal year 1930, and three in 1929.

PUBLIC AMUSEMENTS AND RECREATION

Activities of the bureau of clubs and playgrounds are supported in part by appropriations as an aid to canal administration because of the service of such activities in promoting health and recreation and maintaining morale among the employees and their families. Opportunity for diversion in the Canal Zone is limited. The community is not self-governing and lacks political interests. There is no industrial activity outside of the canal work, and initiative and ambition find little outlet but in the day's work. The employees live in houses owned and controlled by the Government and can not develop permanent and personally owned homes in the Canal Zone. The evening amusements in territory adjacent to the Canal Zone are principally automobile drives, moving pictures, boxing, clubs, and saloons. Such environment, within and without the Canal Zone, is not constructive and the activities of the bureau of clubs and playgrounds aim at furnishing wholesome community interest. The annual appropriation, \$120,000, averaging approximately \$10,000 for each of the 6 gold and 5 silver clubhouses and 1 silver clubroom, is about one-fifth of the total cost of their operation; the other four-fifths are collected from patrons in the form of charges for services rendered. Clubhouses for gold employees are operated at Ancon, Balboa, Cristobal, and Gatun, with an annex in New Cristobal; for silver employees at Cristobal, Gatun, La Boca, Paraiso, and Red Tank, with a clubroom at Gamboa.

The work was continued essentially as in previous years. The most important development in the year was the installation of sound-picture apparatus in the gold clubhouses at Ancon, Balboa, Cristobal, and Gatun and the silver clubhouses at Cristobal and La Boca. These installations increased attendance at the moving pictures beyond expectations, with the effect of stimulating other clubhouse business. Receipts from all sources at those clubhouses showing sound pictures aggregated about 30 per cent more than in the preceding fiscal year. Silent pictures continued to be shown at the gold clubhouse at Pedro Miguel and the silver clubhouses at Gatun, Paraiso, and Red Tank, but with the decrease in available silent films it will be necessary eventually to discontinue shows at these clubhouses or install equipment for sound projection. As in previous years, films were furnished free of charge for picture shows at Palo Seco leper colony, Corozal Hospital for the Insane, and the Canal Zone penitentiary at Gamboa.

In addition to the moving pictures, the clubhouses provide bowling, pool, reading rooms, and branch libraries, and limited refreshment and restaurant service and are centers for community entertainments and athletic enterprises. They are open daily from 7 a. m. to 11 p. m. As related activities, 16 concrete and 5 grass tennis courts are maintained, as well as various athletic fields and ball parks, and for the small children playgrounds are operated where kindergarten activities and supervised play may be carried on. The average attendance at kindergarten was about 250 per day. Two swimming pools are maintained and a boathouse is also kept open near Fort Amador, where transportation is available to visit Farfan Beach on the opposite side of the canal.

Plans for the development of Farfan Beach are under way. Because of the relative difficulty of access by boat, a macadam road to connect the beach with the new Thatcher Highway is under construction. The channel of the Farfan River is being diverted so as to improve the beach. An area including the water front from the Palo Seco Reservation to the Thatcher Highway, opposite Balboa, and extending inland approximately a mile, was set aside during the year as a recreational area. A part of it is to be used as a target range by the Canal Zone police and the Balboa Gun Club.

The auditoriums of the clubhouses continued in use during the year for concerts or vaudeville performances by traveling troupes, dramatic and other entertainments given by high-school students or other local talent, school commencement exercises, etc. Card parties continued to be popular at most of the clubhouses. Military bands from various garrison posts gave concerts regularly at clubhouses of the larger towns; and the boys' bands of Balboa, Cristobal and Gatun were active in furnishing concerts.

Child Health Day was observed on May 1, 1931, for the first time in the Canal Zone, with programs of exercises, discussions, etc., conducted under the joint supervision of the health department, the division of schools, and the bureau of clubs and playgrounds.

The personnel of the Army and Navy stationed on the Isthmus have the privileges of the clubhouses, in addition to the entertainment provided for them by the two services and by the Army and Navy Y. M. C. A.'s. The clubs and playgrounds at the terminal towns are used extensively by Navy personnel during the visits of vessels, and this is especially the case at times of fleet concentrations at the canal. Transient visitors to the Canal Zone, who are not Government employees, have the privileges of the clubhouses except for the purchase of dutiable merchandise.

In the silver clubhouses for colored employees motion pictures are the principal entertainment and other features are literary clubs, local entertainments, community nights consisting of educational or

ordinary motion pictures shown without charge, talks on education, child-welfare work, dances, etc. Graduation exercises for the eighth grade of the colored schools were held at all the silver clubhouses on June 26. Various forms of athletics, indoor and outdoor, enlist extensive participation, and some of the clubhouses are used by teachers of shorthand, typewriting, and other subjects.

A new grandstand was built at Pedro Miguel during the year, at a cost of approximately \$1,250. Including this, approximately \$35,000 was spent on repairs of the buildings, which are in general in poor physical condition. Only such repairs are made as are necessary, in view of the expectation that the houses will be replaced by new structures as soon as funds can be procured. New clubhouses are needed at Ancon, Balboa, New Cristobal, and La Boca. A swimming pool at Gatun for white employees and swimming facilities at all colored communities are urgently needed, as well as playsheds for the small children. Small playgrounds equipped with some apparatus, such as swings, baseball back stops, volley-ball courts, but without immediate supervision, are needed at various points in Ancon and Balboa where children can play when it is not convenient to go to the larger playgrounds. New playground equipment is needed at all playgrounds. Band stands are needed at Ancon, Balboa, Pedro Miguel, and New Cristobal.

The astronomical observatory established last year near the Miraflores filtration plant through the initiative of the Canal Zone Astronomical Society and the use of \$1,750 from clubhouse funds for the erection of the observatory, was opened to the public on July 21, 1930, and continued in use throughout the year. The bureau of clubs and playgrounds expended small sums for maintenance of the plant. Monday evenings were set aside for parties of enlisted men of the Army, and beginning on January 13, 1931, Tuesday evenings were devoted to a series of lectures, at first on astronomy and later on other subjects of general interest, in so far as authorities could be secured to deliver them. These lectures were given through several months and were abandoned with the approach of the rainy season. The prevalence of clouds during the rainy season, embracing two-thirds to three-fourths of the year, interferes considerably with the use of the telescope but on clear evenings the observatory is visited by numbers of interested persons, including a gratifying proportion of school children.

ADMINISTRATIVE PROBLEMS

One of the major duties of the governor and his assistants is planning improvements, both in present administration and facilities and in provision for future needs. Brief discussions of some of the more important matters affecting operations are presented herewith.

GENERAL PROGRAM

In anticipation of future needs the canal administration has prepared a program of work to be carried on during the next 10 to 15 years, perhaps later. For the more immediate needs it has developed a 5-year program, for which a total of about \$15,000,000 is required, at the rate of \$3,000,000 per year. This is exclusive of the Madden Dam construction. The decrease in national revenues resulting from the current depression has led to some deviation from this plan for the purpose of diminishing appropriations; the tentative estimates submitted for the fiscal year 1933 for such betterments under the 5-year program call for the appropriation of approximately \$2,346,000. In addition to projects to be paid for by special appropriations certain of the supply department and Panama Railroad activities will be paid for by the Panama Railroad Co., replacements and developments in various divisions will be charged to accumulated reserves, and minor items will be included in the regular appropriations.

WORK IN FISCAL YEAR 1931

In line with the program of replacements and betterments the appropriations for the fiscal year 1931 included \$200,000 for a new ward for male patients at Corozal Hospital for the insane and cripples; \$132,000 for towing locomotives at the locks; \$32,000 for crib fenders at the Pacific locks; and several minor items, which, with the foregoing, brought the total to \$406,400. In addition there were the appropriations of \$2,000,000 for the Madden Dam and \$500,000 as the first half for the Thatcher Highway from the west bank of the canal at Balboa to the boundary near Arraijan, and the two ferryboats for crossing the canal. These brought the total of special appropriations to \$2,906,400. The work for which these appropriations were made has largely been accomplished, but some portion of this construction was carried over into the ensuing fiscal year.

WORK IN FISCAL YEAR 1932

Appropriations made for the fiscal year from July 1, 1931, to June 30, 1932, include continuation of Madden Dam, \$1,000,000, with authority to enter into contracts for work involving expenditure of \$11,250,000 more; completion of the Thatcher Highway and ferry, \$500,000; high school at Cristobal, \$825,000; colored elementary school at La Boca, \$125,000; nurses' quarters and alterations, Colon Hospital, \$100,000; fire stations, Pedro Miguel and Gatun, aggregating \$35,000; and buildings and improvements at the locks aggregating \$83,350; the total for all being \$2,668,350 without inclusion of the amount which may be obligated by contracts for the Madden Dam work.

ESTIMATES FOR FISCAL YEAR 1933

The tentative estimates for the fiscal year 1933, subject to change, are to include \$4,500,000 for continuation of the Madden Dam project and \$2,346,000 for various betterments. The latter include \$625,000 for the Balboa high school and junior college, which is one-half of the total estimate; \$500,000 for permanent quarters for American employees; \$400,000 for the enlargement of the dry dock at Cristobal; \$190,000 for police station and magistrate court at Balboa; \$180,000 for library building at Balboa Heights; \$120,000 for quarters for alien employees; \$80,000 for widening La Boca Road; \$66,000 for filling ground to be occupied by supply department and municipal division activities; \$50,000 for a private ward for white patients at Corozal Hospital; \$50,000 for home at Corozal Hospital for superannuated alien employees; \$50,000 for widening streets in the southern district, etc.; \$25,000 for new roads in Corozal Cemetery; and \$10,000 for additional roads around existing buildings at Silver City.

EXPLANATION OF IMMEDIATE NEEDS

The 5-year and 15-year programs have been explained in some detail in special reports to the Secretary of War, the Director of the Bureau of the Budget, and members of the appropriations committees of Congress. It is not practicable to repeat these details within the limits of the annual report, but the following facts with regard to major projects, for which appropriations are requested for the fiscal year 1933, are believed to be of general interest:

Balboa high school and junior college.—The present Balboa school main building (for white children) was constructed in 1917, when the enrollment was 528. No permanent additions have been built since that time, although the enrollment has increased to 1,338 in 1931, and the normal growth will be increased by several hundred pupils upon the completion of the Albrook Field project. At present only 25 of the 43 teachers at Balboa are housed in the main building; the 18 others are in 5 separate wooden buildings converted for school use. All of the more than 700 high-school pupils are crowded into the main building, and no satisfactory accommodations are available for science laboratories, library, manual training shops, and household arts rooms. The situation is one of crowding and of inadequate equipment. As a remedy it is proposed to construct a new building at a cost of approximately \$1,250,000 to house the high school and, with some expansion, to serve also as a junior college. Moving the high school from its present building will release the latter for use of the elementary schools following alterations estimated to cost \$70,000. This will make it practicable to assemble there the classes now scattered in temporary wooden buildings and will make for

much more effective school work in addition to releasing those temporary wooden buildings for other uses.

Quarters for employees.—Provision of quarters on the Canal Zone has always been inadequate. The situation calls for relief. At the time of completion of canal construction and the gradual change from construction conditions to those of permanent operation and maintenance, the United States was concerned primarily with the World War, and canal appropriations were held down so strictly that no allowance was made for building quarters. This situation continued after the war and it was not until the fiscal year 1927 that appropriations were made for more quarters. In the meantime the deterioration of old buildings, some of which have been in service from the days of the French canal companies, has been such that many had to be abandoned. The matter of quarters is extremely important in the operation of the canal. With insufficient quarters a considerable portion of the force has to seek housing in the cities of Panama and Colon, where rents are high, accommodations generally inadequate, and conditions of environment less satisfactory than in the Canal Zone. For the satisfactory operation of the canal and the better maintenance of discipline and morale it is desirable for the employees to be housed fairly close to their places of work and under American protection.

Quarters for American employees.—Following the close of the construction period, no appropriations were secured until the fiscal year 1927 when \$384,278 was allotted; in 1928 the appropriation was \$499,943; in 1929 and 1930 it was \$400,000 each year. For 1931 and 1932 no appropriation was made and the governor was directed to use \$400,000 of Panama Railroad funds for quarters. The long period without any new building has made it necessary to do extensive building now as a matter of replacement. The program adopted calls for \$500,000 for gold quarters each year and \$600,000 or \$700,000 would be better. At \$500,000 per year it will take about 24 years to replace the present old quarters. Due to the severe conditions of the Tropics the canal will have practically a continuous program of replacement of wooden buildings. A type of building using concrete for a basement and supporting pillars and lumber for the superstructure has been found to be the best adjustment between initial cost and endurance.

Quarters for alien employees.—The combined force of alien employees of both the canal and Panama Railroad is now approximately 12,000, of whom about 4,000 are quartered in the Canal Zone, the balance residing in Panama and Colon, where they are subjected to relatively higher rentals and extraneous influences that make for instability of force. It has been the aim of the canal administration ultimately to provide quarters in the Canal Zone for about 50 per cent of all

alien employees. The superior housing facilities and surroundings promote a more effective force, under better control, and have valuable effect on morale. Privileges of quarters are highly prized, and are forfeited with great reluctance. The expense of expansion of alien quarters for the past several years has been borne by the Panama Railroad Co. and with the completion of authorized expenditures its investment will amount to over \$750,000, or somewhat more than half the value of all alien quarters, whereas the railroad's portion of the combined alien force is only about 25 per cent. It is proposed to expend \$120,000 annually to provide quarters in the Canal Zone for silver employees, the greater part of whom are now living in Panama and Colon.

Enlargement of dry dock at Cristobal.—The present dry dock was acquired by purchase from the second French canal company and is about 40 years old. It is nearly obsolete and is too small to take the larger dredges belonging to the canal, as well as some of the submarines and other small craft that are dry-docked and overhauled by the mechanical division. Its enlargement will enable a more efficient balancing of work between the Cristobal and the Balboa shops, provide additional emergency facilities and obviate the necessity of using the large Balboa dry dock for small craft that could be dry-docked advantageously on the Atlantic side. The present dry dock measures 316 feet in length, 50 feet in width, and 13½ feet in depth over the sill. It is proposed to increase the size to 390 feet in length, 58 feet in width, and 22 feet in depth. The estimate of \$400,000 covers the cost of enlarging the dry dock, providing a floating caisson gate, construction of a pump house, purchase and installation of pumping machinery, and provision of the customary dry-dock equipment. The present wooden miter gates have deteriorated to such an extent that they must be replaced in the near future; the expense of this work would be considerable and would be entirely lost if done before the enlargement of the dry dock.

Police station and magistrate court at Balboa.—The building now occupied was originally erected at Empire in 1907 and was transferred to Balboa in 1915. It is insufficient in size and the building has deteriorated with age and the ravages of termites. It is proposed to erect a modern concrete building suitable in dignity and service.

Library building at Balboa Heights.—The Panama Canal library now occupies the ground floor of the right wing of the administration building, exclusive of the L. This space is needed for canal offices, and is also inadequate for the library, which is much crowded and is without storage room for books or documents used infrequently. It is proposed to erect a separate library building on the slope opposite the south wing of the administration building to be convenient for the

community and readily available for reference in official work. The cost of the building is estimated at \$180,000.

Other improvements.—The necessity for widening the La Boca Road arises from the fact that it is one of the principal thoroughfares for traffic between Balboa, including the docks, and Panama City and traffic will be increased greatly with the opening of the Thatcher Highway presumably in April, 1932; the road will then carry the greater part of the load between the interior of Panama and the Canal Zone-Panama City area.

The filling of ground to be occupied by supply department and municipal division activities is a first step in the development of what is known as the Corundu project which is to involve a total of \$1,067,500 expended over five years. With the building of Albrook Field the Gaillard Highway will be relocated between the Tivoli crossing and Diablo, to the south and west of Albrook Field and to the north and east of the Panama Railroad. It is proposed to develop the area between Albrook Field and the Panama Railroad along this road for use in its eastern part as an industrial area, where will be the motor car repair shops and garage, the district quartermaster's shops, the constructing quartermaster shops, and the municipal division shops and storage; and in the western part as a recreational area, to be occupied by a stadium, ball grounds, etc. This composite reclamation is known as the Corundu project. The removal of shops to the industrial area will give them better facilities, will center related work, and will allow clearing away obsolete and uneconomical buildings. The space thus freed can be used for quarters or other purposes. Establishment of the recreational grounds in the western or Balboa part will liberate space needed for the schools.

At Corozal Hospital, which is for the insane, cripples, and superannuated alien employees, there is an urgent need for a small ward for white patients to house some 20 male and 10 female patients. At present patients of all classes, colored, foreign, enlisted personnel of the Army and Navy, and Panama Canal employees and members of their families, must be cared for without adequate separation. Another special building is required as a home for superannuated alien employees. The number of alien employees unfit for further service is increasing with the passage of the years. While it is possible to care for some of them with the present equipment at Corozal Hospital, the facilities are inadequate to meet the need and the erection of a special building is considered the best answer to the problem.

Appropriations for widening of streets are required principally because the streets in question were laid out on a money-saving basis prior to the development of automobile traffic. The streets are inadequate to handle the traffic in their present condition and widening is sought as a means of relieving congestion and reducing traffic accidents.

RETIREMENT AND SUPERANNUATION

The passage of the Denison Retirement Act, approved March 2, 1931, to be effective July 1, 1931, established improved provisions for the retirement of Panama Canal and Panama Railroad employees on the Isthmus who were citizens of the United States, superseding the provisions of the national law of May 22, 1920, as amended, and of the pension plan of the Panama Railroad Co. The law of March 2, 1931, increases the pay-roll deduction for retirement purposes from $3\frac{1}{2}$ to 5 per cent; provides automatic retirement at age 62 after at least 15 years of service on the Isthmus; optional retirement at 60 years after at least 30 years of service; and voluntary retirement on a reduced annuity at age 55, after at least 25 years of service, with a provision for voluntary retirement at age 55 without reduction of annuity for those employees who have rendered at least 30 years of service of which not less than 3 years were between May 4, 1904, and April 1, 1914. The law includes also provisions for disability and involuntary separation from the service after certain ages. The annuities payable are based upon length of service, the annuity purchasable by the sum of the employee's payments into the retirement fund, and the amount of service rendered during the construction period, between May 4, 1904, and April 1, 1914; in general, other than for the employees with construction service they may be said to be about 25 to 30 per cent higher than the annuities under the national law of May 22, 1920, as amended. Salary deductions under the canal retirement law are approximately 43 per cent higher than under the general law.

Experience will possibly show the need of changes in the law of March 2, 1931. It is, however, considered a distinct improvement on the prior law and a means of contributing both to the proper care of employees after years of service in the tropics and to the maintenance of an effective force for the operation of the canal and its adjuncts.

With respect to the alien employees, the situation is less satisfactory. There is no legislative provision for taking care of those who through superannuation or other physical inability are unable longer to perform full duty and should be removed from the working force. Such employees of the Panama Railroad Co. are given pensions ranging from \$7 to \$30 per month, but there is no authority to do this with employees of the Panama Canal. All that can be done for them now is to offer them care at Corozal Hospital, where there are no accommodations for their families, or to carry them on the rolls at reduced pay, at rates from \$15 to \$35 per month, to perform such work as they can. It would be much better to pension them outright and let them remove from the sphere of canal work.

To secure some degree of relief there has been included in the estimates for 1933 the sum of \$10,000 for payment of cash relief to dis-

abled alien employees, of not exceeding \$30 per month, under such regulations as may be prescribed by the President.

With the cooperation of the Bureau of Efficiency data are being compiled for the purpose of determining as nearly as possible the extent and cost of pensioning alien employees under a retirement law, yet to be prescribed, with definite provisions as to age, length of service, maximum and minimum annuities, etc. For the present, however, only the simpler provisions are desired, as set forth in the preceding paragraph.

CAPACITY OF THE CANAL

A study of the capacity of the Panama Canal for transiting ships, both with the present twin flights of locks and with the proposed third flight, was presented in the annual report of the governor for the fiscal year 1929, pages 70 to 74. The decrease of traffic ensuing from the present business depression has pushed further into the future the need of greater capacity, but it is to be expected that there will be a renaissance of activity. It is desirable to have available all possible information for the guidance of the President and Congress in considering and ultimately deciding the matter of the construction of a third set of locks. Studies made during the past fiscal year have led to some revision of estimates, and revised data are set forth as follows:

The capacity of the canal is dependent on the rate at which ships can be passed through the locks and on a water supply sufficient to maintain a working depth of water in the lock and lake sections.

The present canal can handle 48 complete lockages a day of 24 hours, except during the biennial-overhaul periods, when one side of one set of locks must be out of service for repairs for about 90 days. During such overhaul the capacity of Gatun Locks is reduced to 27 lockages a day; the Pacific Locks under overhaul can also accomplish 27 lockages a day.

There are variations in the numbers of ships arriving for transit. Peak days occur. Experience has shown that these peaks exceed by about 50 per cent the prevailing average per day. Hence when the average of 32 lockages per day shall have been reached there may be anticipated peak days of 48 lockages, reaching the full capacity of the present twin-lock canal. When an average of 27 lockages is reached peak loads will exceed the capacity of the locks during overhaul. As approximately one lockage per day is needed for the handling of noncommercial vessels (Army and Navy ships, vessels of Panama and Colombia, etc.) an average of 26 commercial lockages represents capacity during locks overhaul. When this average is reached the third flight of locks should be available for use.

It is planned to build the third flight of locks directly alongside the existing locks. It is estimated that the cost will be approximately \$140,000,000 and that in the interest of economy it would be advisable to extend the construction period over 10 years. That is, work should be begun when the growth of traffic shall indicate that an average of 26 commercial lockages per day will be attained about the end of the tenth year following. The new locks will contain improvements and require a shorter period for overhaul than the present ones, approximately 30 days as compared with about 45 days for each side of the present twin locks.

After the third locks are completed the minimum lockage capacity will occur every two years during the period of overhaul of locks and while the new flight is under repair. Capacity will then be the same as the present normal maximum capacity, 48 lockages per day.

Water supply.—The critical periods for water for lockages are toward the end of dry seasons of exceptional length and dryness. The dry season of 1920 shows the lowest water supply of any year since the construction of Gatun Dam, and is taken as typical. The length of the season during which it was necessary to use storage water from Gatun Lake was 158 days. The lake had in storage the water from 87 feet to 80 feet elevation above sea level, and considering yield from the watershed, minus the losses through evaporation, leakage, and municipal supply, there was available in this time for lockage an aggregate of 31.02 billion cubic feet of water. Under practical operating conditions the transit of a single ship or a pair of ships locked tandem involves the use of approximately 6,500,000 cubic feet. Based on this requirement, the water supply for the dry season of 1920 would have been sufficient for 29 lockages per day during the 158 days in which stored water would have been needed. Since the third flight of locks should be built by the time commercial traffic requires an average of 26 lockages per day it is seen that the present water supply is sufficient for the operation of the existing locks, provided the electric load is shifted from the hydroelectric station to the Diesel plant.

Madden Reservoir.—While the additional water supply to be provided by the construction of the Madden Dam at Alhajuela may not be necessary for lockages until the third set of locks is in service, it is desirable to have it now to increase dry-season water supply so as to prevent the depth of water in Gaillard Cut from being less than 42 to 43 feet; to control exceptional floods, like that of October, 1923; and to reduce the cost of operating the Diesel electric plant during the dry season. The first two of these reasons are very important. It is in connection with the third set of locks that the Madden Dam

storage will be most useful. This storage will be 22,000,000,000 cubic feet, and its addition to the storage in Gatun Lake will provide, for a dry season like that of 1920, a combined storage of 53,000,000,000 cubic feet. As the third locks will be larger than the present locks, the amount of water needed per lockage will be approximately 7,300,000 cubic feet. Using this figure, the combined storage will suffice for 43 lockages per day. The supply will therefore be nearly sufficient to operate the three sets of locks at their limiting practicable capacity, considered to be 48 lockages per day. An additional supply, sufficient for 6 lockages per day, can be obtained by deepening the canal through Gatun Lake and Gaillard Cut to the elevation of the upper sills of the present locks, which will permit the use of an additional 2% feet of storage in Gatun Lake.

Capacity in net tons.—The average number of net vessel-tons, Panama Canal measurement, handled per commercial lockage during the period of the past five fiscal years was 5,000. This average could have been increased greatly if conditions had demanded greater use of tandem lockages; and studies have shown that it is practicable to raise the average at least to 7,500 net tons per lockage.

Twenty-six lockages per day at 5,000 tons per lockage allows an annual traffic of 47,500,000 net tons; at 7,500 tons per lockage this would be 71,000,000 net tons. It is safe to state that the present capacity of the canal is 70,000,000 to 75,000,000 Panama Canal net tons per year.

Ultimate capacity.—Following the completion of the third locks the lockage capacity will be 48 per day. Based on 48 lockages per day with 7,500 net tons per lockage the capacity with the third set of locks would be 126,000,000 tons per year, at 8,000 tons per lockage it would be 134,000,000 tons, and at 8,500 tons per lockage it would be 142,000,000 tons. It is believed the increasing size of ships transiting the canal will bring the average of tons per lockage to 8,000 and perhaps to 8,500 by the time the daily average number of lockages reaches 48.

Studies have been made which show that it will be practicable to augment the water supply for lockages at a reasonable cost by pumping sea water into Gatun Lake. As there is no physical difficulty in the way of constructing additional sets of locks, it is apparent that the ultimate capacity of the Panama Canal may be increased to any amount desired by constructing additional locks and installing the necessary pumping equipment.

Sea level canal.—Preliminary studies of a project for converting the lock canal at Panama into a sea level were made, along lines suggested by Mr. S. B. Williamson, formerly division engineer in charge of the Pacific division in the construction of the canal, and now a member of the Interoceanic Canal Board. These led to the

conclusion that, from an engineering standpoint, it would be theoretically possible to convert the present lock canal into a sea-level canal. Such a conversion would involve three major projects, viz: Excavating the summit level to elevation 42 feet below mean sea level; removing the existing locks and constructing tide locks at the Pacific end of the canal; and diverting or controlling the flow of the Chagres River and other streams. Without first constructing a third set of locks it would be extremely unwise, because of the risk of totally and indefinitely interrupting traffic, to attempt such a conversion, and, with the construction of the third set of locks it is estimated that the canal would then be adequate to accommodate traffic for another century. In view of this, the undertaking of the conversion project at this time is economically unsound.

Growth of traffic.—The average number of lockages per day in 1930 was about 17, the Panama Canal net tonnage of transiting ships was about 30,000,000 tons per year. It seems a fairly safe prediction to estimate the growth of traffic as not over 10,000,000 Panama Canal net tons per decade, and to estimate that the third locks will be required in from 40 to 45 years. This would be approximately 1970 to 1975, and on such basis work should begin about 1960.

Estimates or prophecies of the extent of traffic in the future can, from the nature of things, have very little accuracy except through accidental coincidence. Many unforeseeable factors affect the traffic, which might be greatly retarded or expanded by such divergent things as general business conditions in the United States, Europe, South America, or eastern Asia, relative output of oil fields, demand for nitrates, the routing of shipments of grain, national customs tariffs, etc. Hence the importance of careful recording of current traffic and at least annual reports on its extent and development, to afford the best possible data for the determination of steps to be taken to assure that the capacity of the canal shall be adequate to commercial and naval needs. It is presumed that there will be a continuing increase of traffic through the Panama Canal, but it is impossible to predict the rate of this increase with any degree of accuracy, and hence it is a very apparent and important duty of the governor of the canal to study the growth of traffic from year to year, so that he may be able to give Congress 10 or 12 years' notice of the time when the third set of locks is likely to be needed.

Hours of operation.—As stated in the report for 1930, the use of the present canal has not reached a point at which operation throughout the 24 hours of the day is necessary in order to handle the traffic. The canal now operates from approximately 6 a. m. to 11 p. m. Vessels are dispatched through the canal from morning until such time in the afternoon as it is impracticable for the ships to pass through Gaillard Cut before dark. Ships arriving too late for through transit

are given partial transit; that is, locked from the Atlantic to Gatun Lake or from the Pacific to the Pacific end of Gaillard Cut (at the upper end of Pedro Miguel Locks), there to be tied up for the night in readiness for an early start the following morning. Suggestions have been made by steamship operators that the canal should operate throughout the 24 hours of the day, to avoid the delays incident to the present schedule, but explanation that present traffic does not warrant the employment of the additional force for such operation, coupled with the element of danger in passing through Gaillard Cut at night, has apparently satisfied patrons as to the justice of the present arrangements.

INTEROCEANIC CANAL BOARD

The President approved on March 2, 1929, a joint resolution of the Senate and House of Representatives authorizing him "to cause to be made, under the direction of the Secretary of War and the supervision of the Chief of Engineers, and with the aid of such civilian engineers as the President shall deem advisable, a full and complete investigation and survey for the purpose of ascertaining the practicability and the approximate cost of constructing (1) such additional locks and other facilities at the Panama Canal as may be necessary to provide for the future needs of interoceanic shipping; and (2) any other route for a ship canal between the Atlantic and Pacific Oceans." The resolution further provided specifically for a survey of the route through Nicaragua, and for the establishment of such stations as may be "necessary for ascertaining the water supply available for the operation of a canal across Nicaragua or elsewhere and for the operation of the additional locks and other facilities at the Panama Canal."

Pursuant to the resolution, the President, on June 17, 1929, designated a board, to be known as The Interoceanic Canal Board, with Maj. Gen. Edgar Jadwin, then Chief of Engineers, United States Army, as chairman, and four other members. Since the establishment of the board, data on various features of the Panama Canal have been furnished to it. Members of the board visited the Canal Zone in the early part of the calendar year 1931 and conferred with Panama Canal engineers. General Jadwin died at Gorgas Hospital on March 2 from cerebral hemorrhage. Some data were also furnished direct to the engineer officer in charge of the Nicaragua canal survey, conducted under the supervision of the Interoceanic Canal Board.

BASIS OF LEVY OF TOLLS

As stated in Section I, under the heading, "Dual measurement system," tolls are at present levied at \$1.20 per net ton on laden ships and 72 cents on vessels in ballast, on the basis of tonnage determined

by the Panama Canal rules of measurement, with the proviso that the amount collectible shall not exceed \$1.25 per net ton nor be less than 75 cents per net ton as determined under the rules for registry in the United States. This makes it necessary for tonnage to be determined and tolls arrived at on two bases, and as the rules of measurement for registry were not designed as a basis for the levy of canal tolls and are considered somewhat arbitrary, and are subject to changes, the dual system occasions confusion and annoyance and at times injustice.

This situation arose from the wording of the acts of Congress and presidential orders by which the rates and the rules of measurement were established. There were, first, the enabling act of Congress, which gave authority to the President to establish measurement and tolls, within the limitations set by Congress; and second, the presidential orders establishing precise methods and rates. The following is a brief summary of the several provisions:

First.—The Panama Canal act of August 24, 1912 (as amended by the act of June 15, 1914, which latter simply abolished exemption of United States ships in the coastwise trade from payments of tolls), contains general provisions for the levying of tolls and authorizes the President to establish rules for measurement of vessels and rates of tolls within the limitations set by the act. The act provided that "Tolls may be based upon gross or net registered tonnage, displacement tonnage, or otherwise"; "may be lower upon vessels in ballast than upon vessels carrying passengers or cargo"; "when based upon net registered tonnage for ships of commerce the tolls shall not exceed \$1.25 per net registered ton, nor be less than 75 cents per net registered ton"; and "if the tolls shall not be based upon net registered tonnage they shall not exceed the equivalent of \$1.25 per net registered ton as nearly as the same may be determined, nor be less than the equivalent of 75 cents per net registered ton."

Second.—Pursuant to the authority vested in him by Congress, as above, the President issued a proclamation under date of November 13, 1912, which established rates on commercial ships as follows:

1. On merchant vessels carrying passengers or cargo, \$1.20 per net vessel-ton—each 100 cubic feet—of actual earning capacity.
2. On vessels in ballast without passengers or cargo 40 per cent less than the rate of tolls for vessels with passengers or cargo.

Third.—The determination of the "net vessel-tons," on which the charges as above were to be levied, was established by the Panama Canal rules of measurement, promulgated by a proclamation of the President dated November 21, 1913.

From the foregoing it is seen that tolls are based on net vessel tons as determined by the Panama Canal rules of measurement, hence not on net registered tonnage; and are limited so as not to

exceed the equivalent of \$1.25 per net registered ton nor be less than the equivalent of 75 cents per net registered ton.

The term "net registered ton" is indefinite, in that each nation has its rules for the determination of registry tonnage. Subsequent to the opening of the canal to commerce the phrase was interpreted by the Attorney General as meaning the net tonnage as determined under the rules for the measurement of vessels for registry in the United States.

It was found in practice that the "United States net" is in nearly all cases considerably lower than the "Panama Canal net," with the practical result that tolls on laden ships are levied on the basis of \$1.25 times the United States equivalent net tonnage. On ballast ships, the rate of 72 cents times the canal net prevails, except that the amount so derived may not exceed \$1.25 times the United States net. Ballast ships pay, as a class, considerably more than the amount which is "40 per cent less" than the charge for like ships when laden.

The heavier charges on ballast ships caused by the existing rules are one element in the interference with levying equitable charges. Assuming they should not pay over 60 per cent of the amount paid when laden, which was accepted as proper when the canal rules were made, they are now being rather heavily overcharged.

Difficulties and inequities occur also in levying tolls on laden ships under the dual system, due to the uncertainty and variability of the net tonnage as measured under registry rules.

The use of the dual system could be terminated by presidential action, in ordering that tolls be levied on the basis of net tonnage as determined under the rules of measurement for registry in the United States; but it is considered that this would make things worse, by abandoning the scientific, equitable, and permanent canal measurement and substituting a system not designed as a basis of levying tolls for cargo-carrying capacity, variable according to minor conditions not affecting capacity, and subject to changes in accordance with rulings of the commissioner of navigation.

Such relief being impracticable, and really no relief, it becomes necessary to request legislation by Congress to establish the single Panama Canal basis. The superiority of the canal basis has not been questioned; the objections to its use arise from the fact that the tolls on some vessels would be increased.

The net tonnage of vessels as determined under the Panama Canal rules is generally so much greater than under the United States registry rules that adoption of the canal rules only with rates of \$1.20 per ton for laden ships and 72 cents for ships in ballast would increase the tolls charges very materially. In order not to increase the aggre-

gate charges considerably, the canal administration has proposed that if the canal rules only be used the rates should be set at \$1 per net ton for laden ships and 60 cents for ships in ballast, with no charges for deck loads. This is designed to return about the same revenue but distribute the charges equitably. The legislation proposed by the canal administration, which has been passed by one chamber of Congress several times but never by both Houses, was before the Seventy-first Congress and was passed by the House of Representatives in the following form:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sentence of section 5 of the Panama Canal act, as amended, which reads, "If the tolls shall not be based upon net registered tonnage, they shall not exceed the equivalent of \$1.25 per net registered ton, as nearly as the same may be determined, nor be less than the equivalent of 75 cents per net registered ton," is amended to read as follows: "If the tolls are not based upon net registered tonnage, they shall not exceed the equivalent, as nearly as may be determined, of \$1 per net ton (determined in accordance with the Rules for the Measurement of Vessels for the Panama Canal, prescribed by proclamation by the President, November 21, 1913, as amended from time to time), nor be less than the equivalent, as nearly as may be determined, (a) of 75 cents per net ton (determined in accordance with such rules, as amended from time to time) in the case of vessels not in ballast, or (b) of 60 cents per net ton (determined in accordance with such rules, as amended from time to time) in the case of vessels in ballast."

SEC. 2. This act shall take effect on the first day of the eighth month following the month in which it is enacted.

Opposition to the remedial legislation has come from operators of United States vessels, principally in the intercoastal trade. It is based on the expectation that the proposed canal basis, with rates of \$1 for laden ships and 60 cents for ships in ballast, would increase their tolls. Such would be the case, at least in many instances; and this is a normal and natural basis of objection from the point of view of such operators. Since the canal administration proposes the change it is incumbent upon the administration to show justification for the change.

Such justification inheres in the fact, on the one hand, that the Panama Canal rules afford an equitable and reliable basis for determining the interior earning capacity of ships are admittedly fair and just to all ships, and the proposed rates of \$1 per ton laden and 60 cents for ships in ballast are not excessive, measured by service rendered, charges at other canals, etc.; and on the other hand, that the United States registry rules, being variable and subject to frequent and more or less arbitrary changes, are not a fair basis for levying canal tolls. Assuming it admitted that the canal measurement rules and the proposed rates based on them are fair it follows that those who would have to pay more for passage as the result of their adoption are now making transit for less than they should pay. In other

words, they are beneficiaries of a system which is not equitable; and are in fact receiving treatment to which, in justice, they are not entitled.

In Section I are published figures showing the amounts by which tolls receipts would have been increased, and the percentage which such increase would be of the tolls actually collected under the present system for the past five fiscal years. This table shows an increase, year after year, of the difference in tolls. Assuming, as is the case, that the canal rules and application under them of rates of \$1 laden and 60 cents ballast would result in tolls directly in proportion to the cargo-carrying capacity of the ships it is evident that something has been operating to reduce the tolls, relative to the norm established by the Panama Canal basis, during the successive years. There have been two causes, (a) variation in the proportions of tonnage in ballast and (b) changes which decrease the net tonnage, as determined under United States registry rules, in comparison with the true cargo-carrying capacity net tonnage as determined by the canal rules. In proportion as the United States net tonnage is reduced the amount of tolls is reduced, although there may have been no changes which would affect the net tonnage (cargo-carrying capacity) as measured under the more scientific canal rules.

Further explanation with respect to the proportions of ships in ballast is as follows: The net tonnage of ships under canal rules is normally considerably greater than under registry rules. Tolls are charged at \$1.20 per Panama Canal net ton for laden ships, 72 cents for ships in ballast, provided the amount collectible may not exceed \$1.25 per United States net ton or be less than 75 cents per United States net ton. This has the effect of limiting the tolls on laden vessels to \$1.25 times the United States net, which is usually much less than \$1.20 times the Panama Canal net; and of allowing collection on ballast ships at 72 cents per net canal ton, unless the amount should exceed \$1.25 times the United States net tonnage. This puts relatively high tolls on ballast traffic, which pays more at present than it would under the proposed canal basis of 60 cents per net ton for ballast ships. On laden ships the proposed canal basis would generally tend to increase tolls somewhat. Therefore, with a high proportion of laden ships the tendency of the proposed basis is to increase tolls over the amount collected under the dual basis; and with a high proportion of ballast ships, adoption of the proposed basis would tend to diminish the tolls.

The following table shows for the past five fiscal years the total laden net tonnage (Panama Canal measurement), the total ballast tonnage, the ratio of laden to ballast tonnage, the amount by which

the tolls actually collected would have been increased, and the percentage which such increase was of the amount actually collected:

Fiscal year	Laden (net tons)	Ballast (net tons)	Ratio of laden to ballast tons	Amount by which tolls would have been increased	Percentage of increase of tolls
1927-----	21,065,813	5,162,002	4.08	\$94,409.79	0.39
1928-----	23,784,839	5,673,795	4.19	300,973.23	1.12
1929-----	25,068,603	4,769,191	5.26	863,057.69	3.18
1930-----	25,737,803	4,242,811	6.07	1,255,801.59	4.64
1931-----	23,606,952	4,185,194	5.64	1,502,499.33	6.10

Study of the foregoing table shows that while the proportion of laden tonnage has increased in comparison with the earlier years the increase has not been as great as the increase in the amount by which tolls collections would have been increased if the proposed basis had been in effect. This discrepancy is emphasized by the figures for the years 1930 and 1931; while the ratio of laden to ballast tonnage decreased from 6.07 to 5.64, the amount of tolls increase advanced from \$1,255,801.59 to \$1,502,499.53. This was an increase of \$246,697.74 in the face of diminishing traffic.

It is evident that something else is operating to increase the disparity between the tolls collected under the existing dual system and the tolls which would have been collected under the proposed canal system. This further factor is the diminishing United States net tonnage in comparison with the net tonnage as determined under the Panama Canal rules.

The Panama Canal rules are constant, and net tonnage determined under them is a fixed and reliable quantity. The following table shows the aggregate Panama Canal net and United States equivalent net of the commercial traffic during the five years, and the percentage which the United States net was of the Panama Canal net:

Fiscal year	Panama Canal net tonnage	United States net tonnage	Percentage, United States of Panama Canal
1927-----	26,227,815	20,565,596	78.4
1928-----	29,458,634	22,863,796	77.6
1929-----	29,837,794	22,793,847	76.4
1930-----	29,980,614	22,683,006	75.6
1931-----	27,792,146	20,595,189	74.1

It is seen that each year the aggregate United States net tonnage is a smaller proportion of the aggregate Panama Canal net tonnage. The amount of tolls collectible on the present dual basis is limited by the United States registry net tonnage measurement; as that decreases it diminishes the tolls. Ships' operators by reducing the United States net decrease their tolls; but the actual carrying capacity as measured by the Panama Canal rules may not be changed. Such reductions of United States net measurement may be made by changes in the ships to take advantage of exemptions of space under

the United States rules, or they may be due to further exemptions following changes in the United States rules.

As long as the United States net can be reduced by such changes the amount of tolls collectible is an uncertain quantity. While it is true that the adoption of the Panama Canal rules, with rates of \$1 per net ton for laden ships and 60 cents per ton for those in ballast, would increase the tolls for some ships, it is to be remembered that the amounts indicated by those rules and rates are in reality the fair levy, and to the extent that tolls are lowered by manipulation of the United States net the Government is being deprived of proper revenue and ships are not being accorded the treatment of entire equality predicated as the basis of the operation of the canal.

The existing dual basis is an evil of long standing and it is hoped that it will shortly be removed by congressional action.

EQUITY OF PRESENT TOLLS

The essential justice of charging tolls at approximately the present level, or slightly higher, was set forth in some detail in the annual report for 1929. The factors there discussed remain in effect and there appears to be now no occasion for a reduction in tolls.

In connection with the occasional recommendations of United States operators that tolls be reduced, it is claimed that such reduction would be an aid to American shipping. In the fiscal year 1931 tolls paid by foreign ships were 54 per cent of the total tolls, those by United States ships in the intercoastal trade 34 per cent, and those by United States ships in foreign trade, 12 per cent. A lowering of canal tolls below the value of the service rendered should be considered in the nature of a subsidy to shipping. On the basis of the traffic in the past year, each million dollars of tolls reduction would represent a subsidy of \$540,000 to foreign shipping, of \$340,000 to United States shipping not in competition with foreign shipping, and of \$120,000 to those ships of the United States which are in competition with foreign flags. It is seen that as far as United States shipping is concerned the greatest reduction would be to vessels engaged in the intercoastal trade of the United States. These vessels are protected against the competition of foreign lines and their competition is with the railroads of the United States. As a matter of national policy the effect of lower canal tolls on the railroads should be given careful consideration. Toll revenues are not now on the increase but expenses of operation and maintenance are, on account of the necessity of replacements and betterments. It appears in line with sound business practice not to lower the rates of tolls below the present levels. On the contrary, the situation by which the Government is being deprived of legitimate tolls through the workings of the dual measurement system calls for relief, to end this unwarranted loss and at the same time to establish the levy of tolls on an equitable basis.

SECTION IV

GOVERNMENT

The civil government of the Canal Zone is conducted as prescribed in the Panama Canal act of August 24, 1912, and other acts and Executive orders made applicable to the Canal Zone. Whenever it has been practicable to assign governmental functions to departments in the organization established for the operation and maintenance of the canal this has been done. Complete cooperation and greater economy and efficiency are derived from such coordination of functions.

Data on the expenses and revenues of various features of canal operation and government are shown in the financial and statistical statements in Section V.

POPULATION

A house-to-house canvass of the civil population of the Canal Zone, including civilian employees of the Army and members of families of Army and Navy personnel but omitting commissioned, warrant, and enlisted personnel, was made by the police force during the month of June, 1931. A summary is presented below:

District	Americans			All others			Total
	Men	Women	Children	Men	Women	Children	
Balboa.....	2,200	2,146	2,095	4,097	2,699	5,352	18,589
Cristobal.....	499	658	727	3,449	2,111	4,600	12,044
Prisoners.....	12			98	2		112
Total	2,711	2,804	2,822	7,644	4,812	9,952	30,745

The above total indicates an increase of 1,158 in civil population over the 29,587 reported in April, 1930, in the fifteenth decennial census.

In addition to the civilian population listed above, the military and naval forces in the Canal Zone in June, 1931, numbered 9,820 (Army, 9,020; Navy, 800), making a total population of 40,565. The total in April, 1930 (fifteenth decennial census) was 39,467, of whom 9,880 were in the Army and Navy (Army, 8,686; Navy, 1,194); in June, 1929, 39,137; in 1928, 37,512; in 1927, 36,600; in 1926, 36,998; in 1925, 37,011.

Of the 30,745 civil population in June, 1931, a total of 8,068 were employed by the Panama Canal and Panama Railroad; of these, 2,702 were Americans and 5,366 aliens. Over 500 American and 5,000 alien employees of the organizations were living outside of the Canal Zone.

PUBLIC HEALTH

The general health conditions of the populations of the Canal Zone and the two terminal cities of Panama and Colon, for the past year, have been good. No epidemics of disease have occurred. The subject is discussed in greater detail in the annual reports of the health department for calendar years, which are issued as separate publications.

VITAL STATISTICS

The morbidity and mortality rate from diseases and injury, and other vital statistics covering the populations of the Canal Zone and the cities of Panama and Colon, are set forth in detail in the calendar year annual report of the health department which is published yearly in pamphlet form. For this reason some of the tables that have heretofore been presented in the annual report of the governor are omitted from the report for the fiscal year 1931 and the discussion of vital statistics has been limited to a brief résumé of the general death rates from disease, birth rates and infant mortality rates.

General death rate.—The total death rates for the Canal Zone population and the residents of Panama City and Colon, for the past five years, have been as follows:

	1926	1927	1928	1929	1930
Canal Zone (employees and nonemployees)	7.79	8.10	8.53	7.67	7.14
Panama City.....	17.34	17.83	20.06	19.36	17.57
Colon.....	14.92	14.03	14.73	16.48	17.40

In the Canal Zone population the general death rates for the past two years have been somewhat lower than for the two years immediately preceding. The total death rate for the Canal Zone for 1930 was the lowest ever attained since construction of the canal was begun under the American occupation (1904). The progress made in the conservation of life on the Canal Zone can best be appreciated when it is realized that during the past 5 years the death rates per 1,000 population have ranged from 7.14 to 8.53, whereas during the period of construction they ranged from 14 to 50.

In Panama City the rates have been practically stationary during the past 5 years (17.34 to 20.06). From 1906 to 1917 they varied from 25.44 to 44.75 per 1,000 population.

In the city of Colon the general death rates have been somewhat higher during the past two years. During the period 1906 to 1917, the lowest rate recorded was 21.82 and the highest 51.42.

Death rate from disease alone.—A more accurate measure of progress attained in health conservation is the comparison of the death rates

from disease alone. For the past five years for the three units of population involved they have been as follows:

	Death rates, disease only, per 1,000 population by calendar years				
	1926	1927	1928	1929	1930
Canal Zone (employees and nonemployees)	6.72	7.20	7.37	6.77	6.13
Panama City.....	16.82	17.16	19.44	18.77	16.81
Colon.....	14.09	13.40	14.20	15.64	16.46

The method of compilation of statistical data does not permit the segregation of deaths due to disease only until 1913. It can be assumed, however, that the rates for 1913 to 1915, inclusive, are representative of conditions that existed during the most favorable phase of the construction period.

During these 3 years death rates (disease only) per 1,000 population of the Canal Zone ranged from 11.30 to 14.43. During the past five years the rates have been slightly less than one-half those prevailing during the latter part of the construction period. The death rate for disease in the Canal Zone in 1930 was the lowest since construction was begun under American control.

Death rates for disease in Panama City have varied but little during the past five years. For the 5-year period 1913-1917 they ranged from 27.19 to 32.85, whereas for the past 5 years the range has been between 16.81 and 19.44.

In Colon the rates have tended to increase during the past three years. During the 5-year period 1913-1917 the lowest rate recorded was 20.59 and the highest was 26.81 per 1,000. For the past 5 years the range has been from 13.40 to 16.46 per 1,000.

Birth rates, including stillborn.—Birth rates for the past five years, including stillborn, have been as follows:

	1926	1927	1928	1929	1930
Canal Zone.....	18.34	15.74	14.84	13.85	13.28
Panama City.....	30.29	35.84	36.06	34.48	37.09
Colon.....	24.92	26.37	26.70	29.01	30.64

There has been a gradual and continuous decrease in the birth rates in the Canal Zone population during the past five years. The decrease in rates becomes more striking when it is realized that the birth rate in 1930 was only one-half that recorded for 1921—a rate of 25.72 per 1,000 of population in 1921 and a rate of 13.28 in 1930.

Birth rates in Panama City have varied within somewhat narrow limits during the past 5 years, but are now appreciably lower than the rates of record 10 to 15 years ago when they ranged from 40 to 48 per 1,000 of population.

Birth rates in Colon have increased slightly during the past 5 years, but are considerably lower than those of record 10 to 15 years ago when the rate was approximately 33 to 38 per 1,000 of population.

Death rates among children under 1 year of age.—Death rates among children under 1 year of age for the past five years have been as follows:

	1926	1927	1928	1929	1930
Canal Zone.....	90	108	115	94	81
Panama City.....	114	120	148	142	121
Colon.....	129	109	104	116	108

Review of the records since 1920 indicates no appreciable reduction in infant mortality rates in the Canal Zone. Prior to that time the rates ranged from 84 to 126 or higher. The rate for Panama City for the past five years has tended to increase, while that for Colon shows a decrease.

MALARIA

Malaria is of seasonal occurrence in the Canal Zone and in the Republic of Panama, beginning about May of each year and ending in December. The disease is held under control in the vicinity of the permanent towns and military stations on the Canal Zone and in the cities of Panama and Colon, principally by the elimination of breeding places of mosquitoes through the initiation of drainage projects from year to year. The malaria season for 1930 was one of the worst that has been experienced in the Canal Zone and throughout the Republic of Panama for some years, and was due somewhat to an unusual rainy season. The rains began in May, continued for a short time, and were followed by a somewhat extended so-called short dry season or Saint John's Summer. This produced ideal conditions for the breeding of malaria-transmitting mosquitoes throughout the entire Republic of Panama. The peak of the occurrence of malaria during the present year was reached early in June, after which it began to decline rapidly. In 1930 it occurred about the middle of June and the high rates continued until about the middle of August. Malaria rates among Panama Canal employees, for the first six months of the year, for the past five years, based on annual rates per 1,000 employees have been: 1927, 8.2; 1928, 13.3; 1929, 21.5; 1930, 27.8; 1931, 16.2. These figures include all employees engaged on large field projects. If cases occurring among employees on such field projects were excluded, the rates would be: 1927, 8.2; 1928, 13.3; 1929, 13.3; 1930, 25.2; 1931, 16.2.

When malaria control measures (drainage, oiling, screening, etc.) on a large scale are first carried out in heavily infected areas in various parts of the world the initial reduction in malaria is spectacular.

Such a reduction occurred in employees of the Panama Canal during the construction period when the malaria rates were gradually reduced from 821 cases per 1,000 per annum in 1906 to 76 in 1913. After the opening of the canal for traffic in 1914, the population became stabilized and between 1916 and 1930 the annual rate per 1,000 has ranged between 11 and 31. It may be said that the rate of malaria in employees under normal conditions, when large field projects are not being carried on in nonsanitated areas, ranges from about 14 to 19 cases per 1,000 of employees each year. For a number of years it has been the policy of the health department gradually to extend the areas in which mosquito control measures are carried out. But, notwithstanding continuous extensions during the past 15 years it becomes increasingly difficult to reduce rates further. For the past 10 complete calendar years the rates in employees have been as follows:

1921.....	15	1926.....	14
1922.....	17	1927.....	11
1923.....	19	1928.....	14
1924.....	16	1929.....	21
1925.....	27	1930.....	26

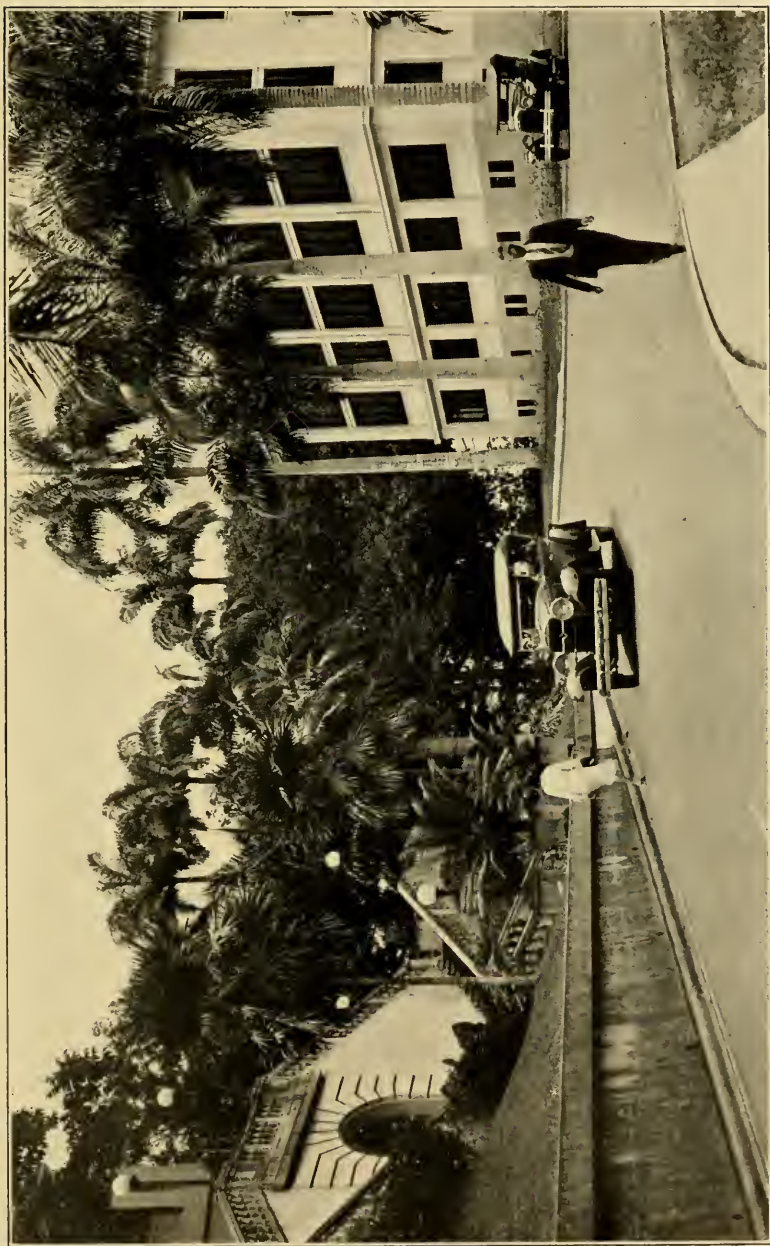
The high rates prevailing in 1925, 1929, and 1930, were due to the fact that large construction projects, beyond the sanitated areas, were under way.

During the year three species of anopheles mosquitoes new to the Canal Zone were discovered—*Anopheles neomaculipalpus* Curry (a new species), *anopheles oswaldoi* Peryassu, neither of which seems important as a malaria carrier, and *anopheles albitarsis* Lynch Arribalzaga. The latter has been discovered in the remote parts of Gatun Lake. This mosquito is considered in South America to be, and probably is, a dangerous carrier of malaria. Undoubtedly it has only recently arrived in the Canal Zone. It is known to prefer large bodies of water as a breeding place, and Gatun Lake with its 165 square miles of water and but 18 years old, offers a logical breeding place for this species of mosquito. Conditions under which it breeds, its flight range, importance, and need for control will receive further study.

The health department of the Panama Canal is much indebted to Dr. H. C. Clark, director of the Gorgas Memorial Institute, and his staff for their cooperation and active assistance during the year; through his active assistance much of the work on malaria and practically all of the work on trypanosomiasis were accomplished.

TRYPANOSOMIASIS IN ANIMALS

From time to time since the construction of the canal the herds of horses and mules in the Canal Zone have been affected with a highly fatal type of trypanosomiasis (a protozoal disease) known as mur-



ENTRANCE TO GORGAS HOSPITAL, WITH NEW ANNEX TO NURSES' QUARTERS ON RIGHT

rina. During the fiscal year, 1930, murrina appeared in the breeding herd of the cattle industry located on the west side of the canal opposite Miraflores. Under direction of the Director of the Gorgas Memorial Institute, and with cooperation of the health and supply departments of the canal and the veterinary authorities of the Army, a survey was made of all mules and horses on the Canal Zone. At that time the disease was found to be confined to the herd at Miraflores. A survey about six months later showed that the disease had gained a foot-hold in horses and mules on the west side of the canal in the vicinity of Gatun Dam. With the destruction of all infected animals and the enforcement of stringent quarantine measures the epidemic appears to have spent its force.

HEALTH DEPARTMENT DAIRY

With the development during recent years of a large dairy industry in the Republic of Panama and by the cattle industry of the supply department, the need for the health department dairy at Corozal, which had been operating at a loss, was no longer apparent and it was closed down and the herd disposed of to the supply department in December, 1930.

GARBAGE DISPOSAL

For several years the garbage collected at the Pacific entrance to the canal has been disposed of at a garbage dump located in the Calidonia section of Panama City. A high-grade residential section is gradually being developed east of the present dumping area, necessitating the abandonment of the present dumping area. After a careful study of various methods of disposal, it was finally decided that the most economical solution was the construction of a roofed-over open-grate incinerator along the Panama Railroad line near Summit. Details of installation were being prepared at the end of the fiscal year and it was expected that the new plant would be in operation within the course of three or four months.

HOSPITALS AND DISPENSARIES

The hospitals and dispensaries and other health department installations have been kept in good physical condition during the year. Extensive alterations were made in the Colon Hospital to increase the bed capacity. The addition to the nurses' quarters at Gorgas Hospital was completed during the year. The construction of a new concrete ward for the disturbed male insane at the asylum at Corozal was begun in December and was about three-fourths completed at the end of the fiscal year.

QUARANTINE AND IMMIGRATION SERVICE

No vessels were detained on account of the presence of a quarantinable disease on board during the year, nor was it necessary to admit any passengers or crew to the quarantine station on account of quarantine regulations.

A total of 445 commercial airplanes were given quarantine inspection. Two lines were operated by the Pan American Airways (Inc.), one to Miami, Fla., via Cuba and Nicaragua, twice a week (in December, 1930, the route was changed to Miami, Cuba, and Kingston, Jamaica); the other to Brownsville, Tex., via Mexico and points in Central America, twice a week. The Pan American-Grace Airways operates from the Canal Zone to Peru twice a week, while the Scadta Lines (the Sociedad Colombo-Alemana de Transportes Aereos) operates to Colombia, South America, once a week. All lines carry mail and passengers. There is also a line running between the Atlantic and Pacific terminals of the canal which carries passengers only. This line, the Isthmian Airways (Inc.), makes three round-trips daily. As it operates within the Canal Zone no quarantine inspection is required.

Quarantine inspection of airplanes becomes of increasing importance each year, since the arrival of carriers of disease during the incubation period is one of the greatest menaces to the Canal Zone, and the rapidity of aerial transportation has extended the area from which passengers may reach the Zone before diseases may have developed sufficiently for detection.

Immigration matters (except Chinese) are handled by quarantine officers for the Republic of Panama as well as for the Canal Zone. This work has been increased by more stringent regulations concerning the entry of restricted aliens into the Republic of Panama, due to industrial competition and unemployment among the Panamanians. As a result, 310 persons were detained for investigation and later released, and 1,053 were deported under the immigration laws as compared with 93 and 675, respectively, during the fiscal year 1930.

The activities of the quarantine division during the fiscal year 1931 are summarized as follows:

Quarantine transactions for fiscal year 1931

Airplanes inspected and passed.....	445
Vessels inspected and passed.....	3, 383
Vessels granted pratique.....	221
Vessels passed on certificates of masters.....	3, 113
Vessels issued provisional pratique.....	0
Total.....	<u>7, 162</u>

Crew inspected and passed (including airplanes)	53, 008
Crew passed by radio.....	62, 497
Crew passed on certificates of masters.....	322, 347
Passengers inspected and passed (including airplanes).....	96, 596
Passengers passed by radio.....	4, 917
Passengers passed on certificates of masters.....	40, 423

Total.....	579, 788
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Vessels detained in quarantine.....	0
Crew detained in quarantine on board ship.....	0
Passengers detained in quarantine on board ship.....	0
Crew admitted to station account of quarantine laws.....	0
Passengers admitted to station account of quarantine laws.....	0
Persons held or detained for investigation and released.....	310
Persons deported under immigration laws.....	1, 053
Supplementary sanitary inspection of vessels.....	4, 085
Vessels fumigated.....	74
Rats recovered after fumigation.....	201
Box cars fumigated.....	136

MUNICIPAL ENGINEERING

Municipal work carried on during the year included the construction and maintenance of roads, streets, sidewalks, water and sewer systems, etc. Varied construction work was performed for the departments and divisions of the Panama Canal, the Army and Navy, the Republic of Panama, and for individuals and companies. The construction of the Thatcher Highway was prosecuted vigorously throughout the dry season, but practically all work was discontinued at the beginning of the rainy season, to be resumed about January 1, 1932. The incomplected portions of Madden Road were concreted during the dry season.

WATER SUPPLY

Consumption of water for municipal uses during the past three years has been as follows:

	1929	1930	1931
	<i>Gallons</i>	<i>Gallons</i>	<i>Gallons</i>
Canal Zone.....	3, 253, 455, 384	3, 106, 895, 340	3, 194, 899, 462
City of Panama.....	1, 392, 912, 000	1, 501, 711, 000	1, 569, 433, 000
City of Colon.....	772, 962, 500	835, 546, 750	843, 412, 250
Sales to ships.....	162, 227, 616	169, 457, 910	172, 248, 037
Total.....	5, 581, 557, 500	5, 613, 611, 000	5, 784, 992, 749

It will be noted that consumption in all areas has increased. Developments in the Canal Zone and both terminal cities indicate further growth of the use of water, and steps have been taken to provide additional storage facilities at both terminals. At the Cristobal-Colon terminal the existing worn out and inadequate 500,000-gallon

reserve water tank is being replaced by two 1,000,000-gallon elevated steel tanks adjacent to the filtration plant and pumping station at Mount Hope. On the Pacific side two 1,500,000-gallon concrete tanks are being constructed on Engineers' Hill immediately adjacent to the town of Corozal; the construction of these two tanks was made necessary by the construction of Albrook Aviation Field, which necessitated an auxiliary water storage supply to serve the requirements of the field, and for the purpose of supplementing the present inadequate storage for the towns at the Pacific terminal.

The quantity of water pumped at each of the pumping stations during the year, the average pumped per month, and the average cost of pumping per 1,000 gallons are shown in the following tabulation:

Pumping station	Total gallons pumped during year	Average gallons per month	Average cost per 1,000 gallons for pumping
Gamboa.....	3, 584, 206, 000	298, 684, 000	\$0. 0244
Miraflores.....	452, 340, 000	37, 695, 000	. 0213
Balboa.....	2, 691, 662, 000	224, 305, 000	. 0186
Paraiso.....	81, 448, 000	6, 787, 000	. 061
Mount Hope.....	1, 927, 317, 000	160, 610, 000	. 0212291
Agua Clara (Gatun).....	387, 730, 000	32, 311, 000	. 0675959
Frijoles.....	5, 896, 000	491, 000	. 1973083
Monte Lirio.....	3, 730, 750	311, 000	. 3029134
Total.....	9, 134, 329, 750	761, 194, 000	. 0260801

All pumps are electrically driven except the Frijoles and Monte Lirio stations which are driven by gasoline engines; these two stations also have as auxiliary units windmills which are operated whenever there is sufficient wind movement.

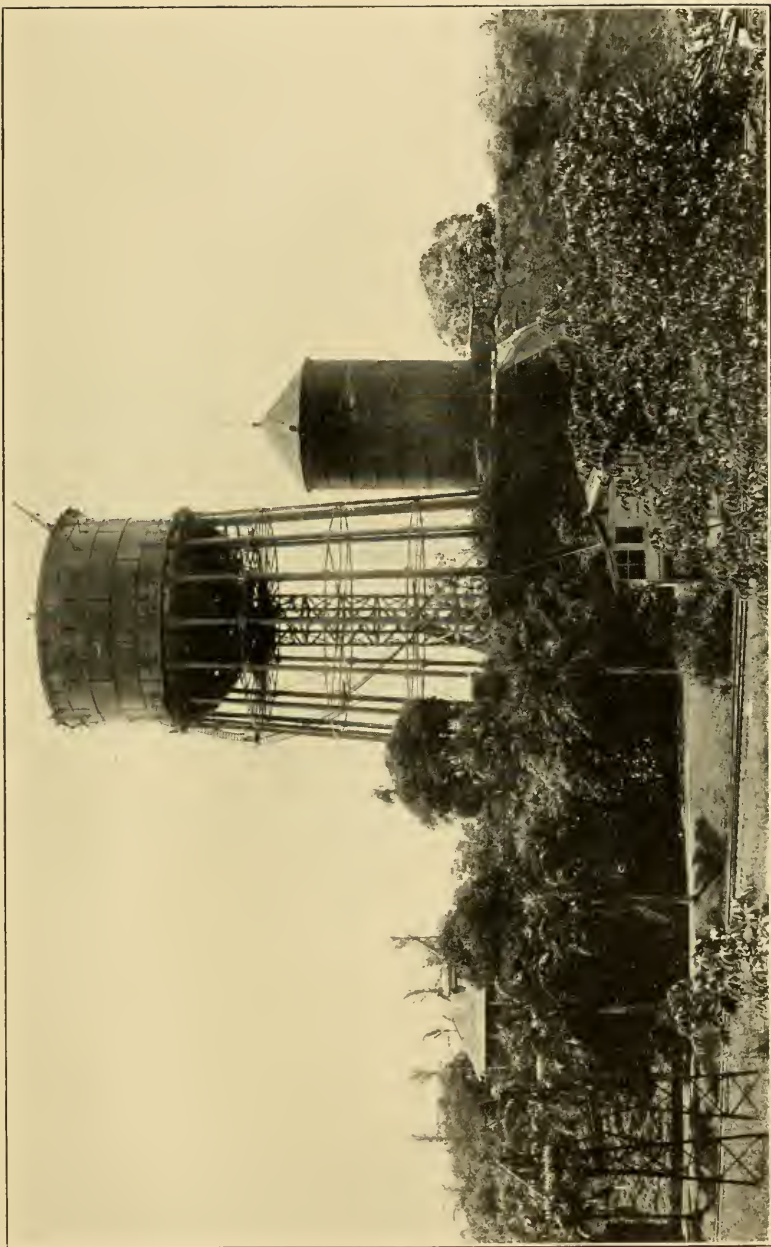
The usual maintenance work was performed on the pipe lines, reservoirs, filtration plants, and pumping stations during the year. In addition to this there were a number of water-line extensions made during the year, notably replacement of water lines on Dock 8 system, construction of third branch of Mount Hope manifold, installation of check valves on dock water systems supplying water to ships, extension of water line from naval radio station to Mindi dairy.

SEWER SYSTEM

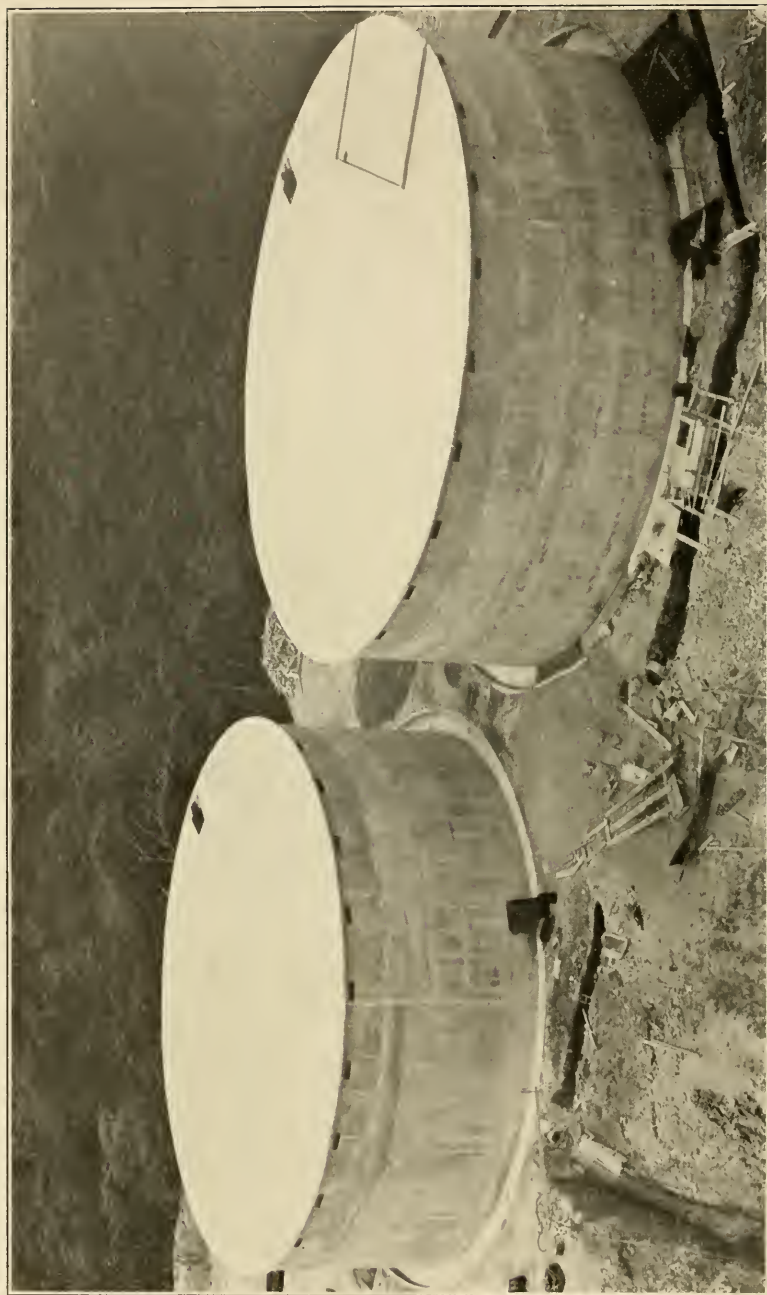
The usual maintenance work was performed during the year on the sewer systems and in addition the following improvements were made: Construction of short section of Corundu River sewer; enlargement of culverts under Fort Randolph spur at Mount Hope; and clean-out storm drains at Silver City, Mount Hope.

ROAD CONSTRUCTION

Thatcher Highway.—Work was started on this project, previously known as the Arraijan Road, at the beginning of the fiscal year. The



FIRST OF TWO 1,000,000-GALLON STEEL WATER TANKS BEING ERECTED AT MOUNT HOPE FOR ATLANTIC END WATER SUPPLY



NEW CONCRETE WATER TANKS, 1,500,000-GALLON CAPACITY, ON ENGINEERS HILL, SOUTH OF COROZAL, FOR PACIFIC
END WATER SUPPLY



THATCHER HIGHWAY. POWER DRAG SCRAPERS MAKING CUT NEAR STATION 315. APRIL 23, 1931

highway when completed will connect with the highway system of the Republic of Panama at the Canal Zone boundary line near Arraijan. It is to be an 18-foot concrete roadway similar to the recently completed Madden Road and will have a total length of approximately 6.73 miles. The project includes the construction of two ferryboats, which were begun during the year by the mechanical division and were to be completed by the first of September, 1931, ferry slips, and a short approach road on the Balboa side of the Canal at La Boca.

The east ferry landing is to be about 450 feet to the south of Dock 4 at La Boca. The west landing will be somewhat to the southwest of the east landing, at a distance of about 1,750 feet or one-third of a mile, and the line between them will cross the canal at an angle of approximately 60° . This diagonal crossing should facilitate the handling of the boats in the strong tidal currents. From the site of the west landing the road follows the shore for about half a mile, part of which is on hydraulic fill pumped from the ferry slip, and then crosses a tidal swamp for 1,500 feet, also on hydraulic fill. About 2 miles from the canal shore the road reaches the Velasquez River, which is followed to its source, the route then crossing over the divide to the headwaters of the Cocoli River and proceeding in the Cocoli Valley to the boundary near Arraijan. Crossing this divide, at Red Bug Hill, was the most difficult part of the location; a climb of 230 feet was made in a distance of 4,800 feet, requiring the heaviest excavation on the line with maximum grades and sharp curvature. At this point, the highest on the road, an elevation of 433 feet is reached, which is 5 feet lower than the Madden Road summit. The last 2 miles are on high ground with but a small loss of altitude at the Zone boundary line.

The Thatcher Highway will have maximum grades of 7 per cent with curves as sharp as 16° (radius 359 feet), as compared with the 6 per cent grades and 15° curves (radius 383 feet) on the Madden Road. A location on a 6 per cent grade was tried on Red Bug Hill but the length required to hold this grade resulted in some very sharp curvature which was not suitable for modern automobile traffic. The change to 7 per cent allowed the line to be shortened sufficiently to straighten out the sharp curves, giving a greatly improved alignment. All curves are superelevated and those of 3° or over are widened.

There is only one bridge on the road, a 25-foot reinforced concrete deck girder span over the Velasquez River. Forty-three culverts are required, and 38 of them were placed during the year. Four are concrete boxes, the remainder pipes from 24 to 60 inches in diameter, all of corrugated galvanized iron except some of the 24-inch pipes, which are of concrete.

The ferry landings consist of an abutment which supports one end of a through truss bridge 176 feet long and an outer structure to be built on concrete piles providing a mechanism for raising or lowering the other end of the bridge to allow for the rise and fall of the tide, the extreme range of which is 20 feet. During the year the piles for both abutments were driven and the concrete work for the west abutment was 75 per cent completed.

Madden Road.—During the year 1,960 square yards of concrete pavement were placed in four locations, namely, the slide at station 53, over the Chilibre and Chilibrillo bridges, and at station 606 where considerable settlement of a rock fill took place. This paving completed the construction of the road.

Paraiso Road.—A section of concrete road similar to the Madden Road was built around Paraiso so as to avoid passing through the town. This section is about a mile in length and saves considerable distance for traffic over the Gaillard Highway from Panama to Gamboa or Madden Dam. The old road through the town is narrow, crooked, and with heavy grades, making it unsuitable for the large number of motor vehicles which will use this road after the construction of the Madden Dam has been begun.

Farfan Beach Road.—This road is about 3,000 feet in length and is intended to connect the Farfan bathing beach, and eventually the leper asylum at Palo Seco and the military reservation at Bruja Point with the Thatcher Highway. During the year six culverts were installed and about 90 per cent of the excavation made. It is contemplated to place the concrete paving early in 1932 in connection with the Thatcher Highway project.

WATER PURIFICATION PLANTS AND TESTING LABORATORY

The water purification plants performed the usual work of purifying the water used on the Canal Zone and in the cities of Panama and Colon. The testing laboratory carried on a variety of work, making a total of 7,263 tests in connection with 4,352 varied samples including mineral oils, cement, oxygen, hydrogen, water, various metals, concrete, and numerous other materials not classified, and testing of water and maintenances of chlorinators at swimming pools and the Gamboa filtration plant. Of the total tests made, 1,589 were in connection with the Madden Dam project. Other principal items were 1,222 tests of water, 1,038 of cement, 881 of fuel and Diesel oils.

PUBLIC ORDER

The number of persons placed under arrest during the year was 3,208, of whom 2,992 were males and 216 females, as compared with 3,270 males and 170 females, a total of 3,440, in the preceding year. The total decrease was 232, or 6.7 per cent. Of the arrests in the past

year, 688 were made on warrants and 2,520 without warrants. Of these cases, 2,224 were convicted, 399 were dismissed, 25 were pending at the end of the year, and 560 were otherwise disposed of on proper authority.

The more common causes of arrest were violations of vehicle and traffic regulations, 1,216; immigration regulations, 391; loitering, 390; disorderly conduct, 204; battery, 146; and petit larceny, 139. The persons arrested included nationals of 85 countries and territories and were of 160 different trades and professions.

There were 7 homicides during the year, 5 of which were the result of persons being struck by automobiles, 1 was due to an automobile accident, and 1 due to accidental discharge of shotgun. There were 8 suicides during the year, 3 Americans, 1 Ecuadorian, 1 Panamanian, 1 Scotchman, and 2 British West Indians. The coroner investigated 64 deaths during the year, 24 of which resulted from accidental drowning. There were no deaths from snake bite.

The number of prisoners serving sentence in the common jails at the end of each month averaged 57, with a minimum of 42 at the end of September, 1930, and a maximum of 87 at the end of July, 1930. All prisoners who were physically able were employed on municipal work, public improvements, janitor and miscellaneous work at the police and fire stations, and at target ranges. The total value of such common jail labor was estimated at \$22,706.57.

Seventeen convicts were committed to the Canal Zone penitentiary during the year, with sentences aggregating 42 years and 9 months; a total of 36 were discharged, of whom 5 were pardoned and 1 was paroled. At the close of the year there were 57 in custody as compared with a total of 76 at the end of the preceding fiscal year. Labor performed by convicts during the year was valued at \$19,191.69, on the basis of standard rates of pay. Convicts were employed principally on municipal improvements, clearing trails, road work, and the cultivation of fruits, vegetables, etc., at the penitentiary farm and the experimental farm at Summit.

Forty-two persons were deported from the Canal Zone during the year. Of this number 31 were convicts who had completed terms of imprisonment, and 11 were persons who had been convicted of misdemeanor charges or who were deemed undesirable persons to be permitted to remain on the Canal Zone.

Continuous patrol of the harbors of Balboa and Cristobal was maintained, principally for the enforcement of the navigation laws and regulations and for the prevention of smuggling and irregular traffic. Two police launches were also maintained on Gatun Lake for patrol of the Chagres River and regular inspection of the 100-foot contour area to determine if any unauthorized clearings or cultivation were

being made, buildings erected, etc. Motorcycle patrols for the enforcement of vehicle traffic regulations and for special emergency police service were continued throughout the year over all the streets and roads of the Canal Zone.

Traffic accidents reported in the Canal Zone during the year totaled 431. These resulted in the death of 6 persons and injuries to 143. A classification of accidents by causes shows that practically all of these accidents were avoidable, due to careless and reckless operators.

Detective officers effected 162 arrests, and in addition made 885 investigations in cases of various natures, to obtain information in criminal cases and to determine the whereabouts of persons wanted in other jurisdictions.

Fingerprinting of all employees of the canal and Panama Railroad on the Isthmus was placed in effect during the fiscal year to establish means of identification. Assistance in this was furnished by the fingerprint expert of the Canal Zone police.

FIRE PROTECTION

During the year 116 fires, 2 special calls, and 5 false alarms were reported. Of these, 77 occurred on property of the Panama Canal, 13 on Panama Railroad property, 2 in United States Army property, 4 in United States Navy property, and 20 in private property.

The total estimated loss from all fires during the year amounted to \$20,503.13, of which \$949.40 was in Panama Canal property, \$175.68 in Panama Railroad property, \$12,800 in United States Army property, \$155 in United States Navy property, and \$6,423.05 in private property. The total value of property involved was \$3,382,009.58. The proportion of estimated loss to valuation was six-tenths of 1 per cent.

Periodical inspections of all Government buildings, docks, storehouses, etc., were conducted and fire extinguishers and other equipment maintained in good condition throughout the year. Sixty-eight fire extinguishers and 2,000 feet of fire hose were added to the equipment, mostly for replacements.

OFFICE OF THE DISTRICT ATTORNEY

The district attorney and his assistant prosecuted 70 criminal cases before the district court. There were 12 criminal cases pending at the close of the fiscal year. Of the 70 cases prosecuted, 21 were for violations of the national prohibition act, 9 for burglary, 4 for assault, 2 for manslaughter, 2 for forgery, and 2 for embezzlement.

The district attorney represented the Panama Canal in an admiralty case against the motor ship *Pyreneas* for charges for wharfage, mooring, materials furnished, and pilotage. There were several inter-

venors, including the Panama Railroad Co. and a local steamship agency.

The vacancy in the office of district attorney existing at the close of the fiscal year 1929-30 was filled by the appointment of Mr. J. J. McGuigan on January 24, 1931.

MARSHAL

During the year there were filed and pending from the previous year in the district court a total of 345 cases, of which 60 were civil, 6 in admiralty, 249 probate, and 30 criminal. In the civil and probate cases there were served 41 summonses and complaints, 36 subpoenas for witnesses, 3 citations, 1 attachment, and 1 restraining order; in the criminal cases, 17 mittimus (penitentiary) and 26 subpoenas for witnesses. Eight juries were summoned during the year. One case of extradition was handled. Five bench warrants were served. One sale in admiralty was effected, that of the motor ship *Pyreneas*, for \$2,500. All narcotics and liquor confiscated during the year were destroyed or otherwise disposed of in accordance with orders of the district court.

Trust funds received and disbursed during the year amounted to \$27,923.51. Revenues collected amounted to \$258.51, and fees paid to witnesses and interpreters to \$50.

DISTRICT COURT

Regular sessions of the district court were held in both the divisions of Balboa and Cristobal throughout the year.

Following is a summary of the cases handled during the year:

	Civil	Probate	Criminal	Total
Cases pending July 1, 1930.....	37	76	7	120
Cases filed during year.....	70	198	67	335
Total.....	107	274	74	455
Cases settled during year.....	60	216	64	340
Cases pending June 30, 1931.....	47	58	10	115

Of the civil cases disposed of, 44 were decided and 16 were dismissed; of the criminal cases disposed of, 7 were acquitted, 36 convicted, 18 dismissed, 1 dropped and 2 were venued and convicted.

Marriage licenses issued numbered 666, deeds recorded numbered 6, and collections from fines, fees, licenses, etc., totaled \$4,693.69.

MAGISTRATES' COURTS

BALBOA

In the magistrate's court for the town and subdivision of Balboa, 20 cases were pending at the beginning of the fiscal year, 1,981 cases

were docketed, and 1,983 were disposed of during the year, leaving 18 cases pending at the close. Of the cases disposed of, 62 were civil and 1,921 criminal. In the latter, 1,556 resulted in conviction, 86 in acquittal, 240 were dismissed, and 39 were held to the district court. During the year petitions were made to the district court for the commitment of 39 persons to the insane asylum for observation. Fines, costs, and forfeitures totaled \$10,889.50.

CRISTOBAL

In the magistrate's court for the town and subdivision of Cristobal, 6 cases were pending at the beginning of the fiscal year, 1,070 cases were docketed and 1,075 were disposed of during the year, leaving 1 case pending at the close. Of the cases disposed of, 85 were civil and 990 criminal. In the latter, 794 resulted in conviction, 95 in acquittal, 50 were dismissed, 9 were forfeitures, and 42 were held to the district court. Fines, costs, and forfeitures totaled \$4,435.

PUBLIC SCHOOL SYSTEM

During the year 2 senior high schools, 2 junior high schools, and 6 elementary schools for white children, and 7 elementary schools for colored children were maintained. All elementary schools are graded. For white children there are elementary schools in Ancon, Balboa, Pedro Miguel, Paraiso, Gatun, and Cristobal, with two high schools, at Balboa and Cristobal. For colored children elementary schools are operated in La Boca, Red Tank, Paraiso, Gamboa, Las Cascadas, Gatun, and Cristobal (Silver City). The school organization is comparable with the usual city school system in the United States, having a superintendent with assistants in general charge and a principal at each school, the towns of the Canal Zone, in each of which is located a school, being compared with the sections of a city where schools are located.

The net enrollment in the month of February, taken as representative, was 2,825 for the white schools, and 4,013 for the colored schools, a total of 6,838; increases over the corresponding month in 1930 were 5.5 per cent for white schools, 5 per cent for colored schools, and 5.28 per cent for the total. The net enrollment for the fiscal year was 3,083 white, 4,230 colored, as compared with 2,923 and 4,080 in the last preceding year. The average daily attendance at the white schools was 2,641.01 and at the colored schools 3,731.41 throughout the year.

The per capita expense of maintenance, based on average daily attendance, amounted to \$62.75 as compared with \$60.39 for the preceding year. The total expenditures for the division of schools during the fiscal year amounted to \$399,814.98. Tuition collected, books and school material sold, etc., amounted to \$14,531.06.

The teacher corps of the Canal Zone schools is composed of 8 principals and 92 teachers for the white schools and 7 principals and 88 teachers for the colored schools. The usual high standards as to educational qualifications were exacted in the employment of new teachers.

Following the recommendations resulting from the survey of Canal Zone schools conducted in the fiscal year 1930 by the division of field studies of Columbia University, four new supervisory positions were filled during the past year. These were director of research, supervisor of art, and two special teachers, one of art and one of music. Art was taught during the past year for the first time as a regular subject in the elementary schools and a 1-year course was offered in each of the high schools.

With the employment of a director of research, an extensive program was carried out along this line during the fiscal year. Achievement and intelligence tests have been administered to all pupils in both the white and colored schools. The achievements of the pupils were found to be very satisfactory as a whole, and about the same general level as indicated by the Canal Zone survey, referred to in the last annual report, which was based on short survey tests administered to about 20 per cent of the pupils.

The Balboa junior-senior high school and proposed junior college is in most urgent need of a new building. The present building was designed in 1917 to house the Balboa elementary school with provision on the third floor for the Balboa high school, which at that time enrolled only 142 high-school pupils as compared with 411 for the present fiscal year. This school is still administered as a single unit and has grown until the overflow from the main building is housed in five additional wooden buildings that have been assigned for school use. These buildings are widely scattered, thus rendering the administration of the school very difficult and impairing the efficiency of the school program. With the completion of the new junior-senior high school at Cristobal and the new colored school at La Boca a considerable handicap will be lifted in so far as these two towns are concerned.

PROPOSED HIGH SCHOOL, CRISTOBAL

The proposed high school, Cristobal, is designed to accommodate about 600 pupils and will cover an area of 46,130 square feet. It will be built of reinforced concrete, with red tile roof, red tile floors in all corridors and laboratories and wood floors in classrooms, similar in construction to the standard Canal Zone permanent structures. The building is designed especially to avoid the extreme sunlight glare in any of the rooms during school hours, all windows having a northern or southern exposure.

The building will be two stories high and is divided into six major divisions connected by covered passageways, forming two patios. The divisions are as follows: A scientific wing on the north; a classroom wing in the center; a domestic science, commercial, administration wing on the south; and a gymnasium, a cafeteria, and an auditorium.

The central division contains 16 of the 17 classrooms, 8 on the first floor for high school and 8 on the second floor for junior high school. In the rear of the central wing will be located a cafeteria to accommodate 150 students and with a properly equipped kitchen and cafeteria counter.

The north wing, on the first floor, will contain the science laboratories, general science and biology, chemistry and physics, and elementary science. On the second floor of the north wing will be a large library-reading room, with shelving to accommodate 3,000 to 4,000 books, and a small study hall.

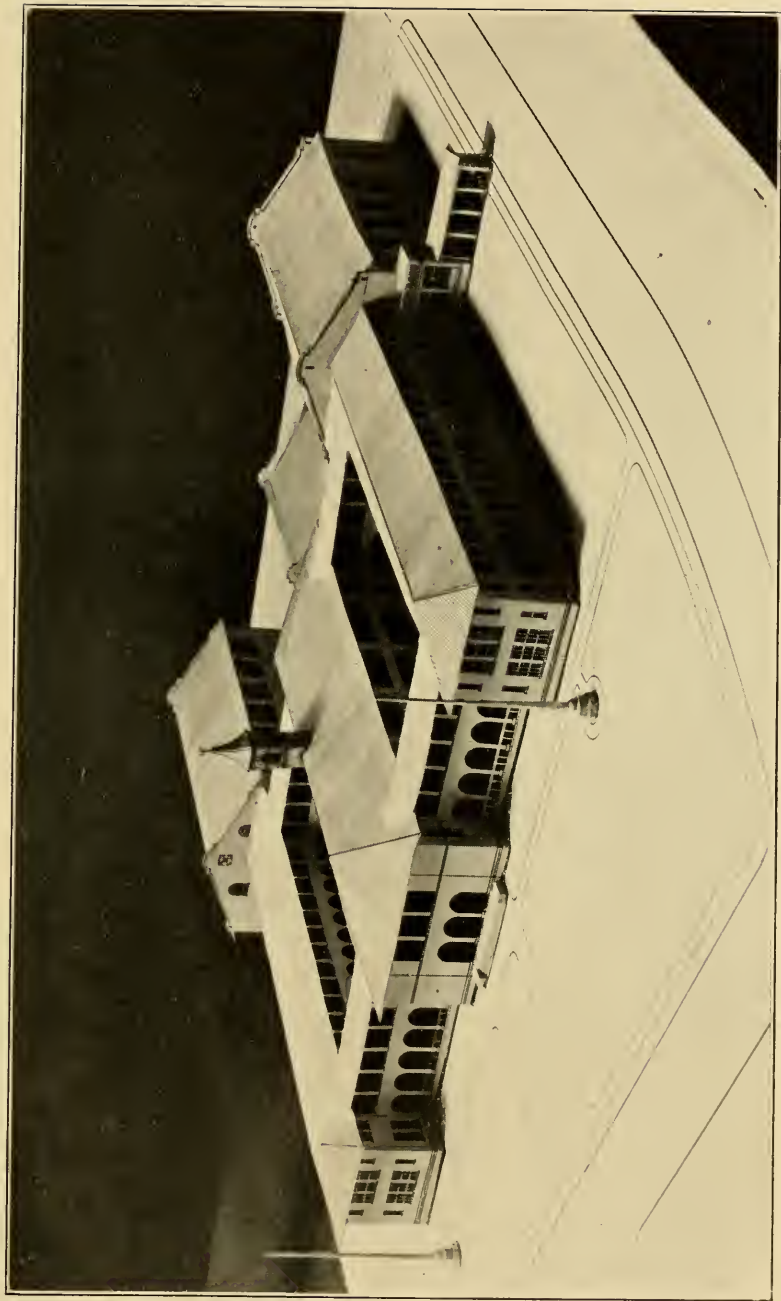
Connected to the north wing is the gymnasium wing. On the first floor will be the ironworking shop, the woodworking shop, and the mechanical drawing room. The gymnasium proper is on the second floor and has connected to it the showers for boys and showers for girls, an office for the physical director and storerooms. The south wing, on the first floor, will have a cooking laboratory, a sewing laboratory, the administration offices, and a book storage room. On the second floor of the south wing will be the bookkeeping room, typewriting room, and a studio for fine arts.

Connected to the south wing will be an auditorium with a seating capacity of approximately 600 people, with a stage and a projection room for motion pictures.

POSTAL SYSTEM

A total of 12 post offices were in operation during the year, all of which, except Gamboa, were authorized to transact money-order business. The gross receipts for the postal service were \$292,500.70, as compared with \$269,922.94 for the previous year, an increase of \$22,577.76, or about 8 per cent. Expenditures aggregated \$212,725.62 as compared with \$214,286.03 for the previous year. During the past seven years the revenues of the postal service have exceeded the expenditures by a total of \$182,914.54. Formerly, 40 per cent of postage sales was paid to the Republic of Panama. This was discontinued in 1925. A large portion of the matter handled is official mail under frank.

The sale of postage stamps, postal cards, stamp books, etc., amounted to \$221,573.68 of the total receipts above mentioned. The practice of issuing deposit money orders without charge in lieu of postal-savings certificates was continued. The system operates



ARCHITECT'S MODEL OF PROPOSED CRISTOBAL HIGH SCHOOL

satisfactorily and at a small expense. The amount on deposit at the close of the fiscal year was \$603,230 as compared with \$428,710 at the close of the previous fiscal year.

Money orders to the amount of \$3,102,444.40 were issued on which fees amounting to \$13,615.38 were collected. Money orders in the amount of \$1,064,645.18 were paid, of which \$576,250 were deposit money orders.

In the registry division of the post offices, 249,063 letters and parcels were handled. Of this number 120,511 were dispatched, subdivided as follows: 30,574 domestic letters; 259 domestic registered parcels; 34,662 foreign letters; 4,109 foreign registered packages; 43,463 official letters and parcels registered free; and 7,444 C. O. D. and insured parcels.

During the fiscal year a total of 2,694 dispatches of mail were made by the Cristobal post office to the United States and foreign countries, and 4,197 dispatches were received. The Balboa post office, which dispatches all mail to the west coast exchange offices of the United States and Central and South America, made 1,709 dispatches and received 1,725 dispatches during the year.

AIR MAIL SERVICE

During the fiscal year many changes were made in the air-mail schedules and routes were modified to afford improved service. On July 1, 1930, the frequency of the express service between Miami and Cristobal, and between Cristobal and Montevideo, Uruguay, respectively, was increased from one to two trips per week in each direction. Schedules have been exceptionally well maintained despite the hazards of the long flights. On February 1, 1931, the service between Cristobal and Brownsville, Tex., and the connecting route from Salvador to Miami was reduced from three trips to two trips per week in order to afford improved service to the east coast of South America without additional expense to the Post Office Department. Shortly thereafter the route between Cristobal and Venezuelan ports was further extended to the Island of Trinidad, which linked up with the service between the west and east coasts of South America. It is proposed to extend the services from Santos, Brazil, to Montevideo, Uruguay, to connect up with the route operating down the west coast from Cristobal, and thereby completely link up South America by air.

The Cristobal post office continued to act as a "clearing house" for all air mail exchange between the United States and South America, and vice versa. The records indicate that the volume of mail has increased during the past year despite the general business depression. They also show that air mail of Canal Zone origin increased approximately 25 per cent during the year in mail destined for Cen-

tral or South America and over 100 per cent for air mail destined to or via the United States.

New permanent buildings are badly needed for the Ancon and Balboa post offices as the present buildings are overcrowded and their condition such that the cost of maintenance is excessive.

CUSTOMS

MOVEMENT OF VESSELS

There was a decrease in the total number of vessels entered and cleared during the year as compared with the preceding year. The total number entered was 12,343 as compared with 13,788 for 1930, and 12,363 cleared as compared with 13,775 for the previous year.

The total number of United States vessels entered was 5,093 and the total number cleared was 5,116 as compared with 6,130 entered and 6,120 cleared during the preceding year.

MERCHANDISE FOR REPUBLIC OF PANAMA

All merchandise discharged at either Cristobal or Balboa, destined to persons or firms in the Republic of Panama, not connected with the Panama Canal, the Panama Railroad Co., or the United States Army or Navy, is in the custody of the Canal Zone customs until submission of the necessary papers from Panamanian officials showing that the duty has been paid. Permits for 10,507 releases were granted at the customhouse at Cristobal and 1,039 at Balboa. The greater part of this cargo is forwarded by railroad to Panama City, there to be handled by the Panamanian customs officials.

FREE ENTRY MERCHANDISE

Employees of the Panama Canal or the Panama Railroad Co., and members of the United States Army and Navy, are permitted to import articles for the personal use of themselves and families without the payment of customs duty to the Republic of Panama. During the fiscal year 5,188 requests for free entry were approved as compared with 5,152 for the preceding year.

VIOLATIONS OF CUSTOMS REGULATIONS

No arrests were made for violation of customs regulations during the year. At each port, however, numerous attempts to smuggle merchandise of various classes, in small quantities, were frustrated, and such merchandise was confiscated and delivered to the proper authorities in the Republic of Panama.

DRUG TRAFFIC

One arrest was made during the year for violation of the narcotic drug import and export act. The defendant was found guilty of

having brought into the Canal Zone a quantity of cocaine and was sentenced to serve four years in jail and to pay a fine of \$1.

HOUSEHOLD INSPECTIONS

During the year inspection was made, under the existing agreement with the Treasury Department, of 507 pieces of freight belonging to employees of the Panama Canal or Panama Railroad Co., or members of the Army or Navy, intended for shipment to the United States. All such goods are inspected and sealed by local customs officers and are admitted into the United States without further inspection by the customs authorities at the port of entry.

SPECIAL CUSTOMS SERVICE

In order to facilitate the discharge of passengers from vessels after the usual working hours at the terminal ports of the canal, special customs service was furnished 330 vessels at the port of Balboa and 505 at the port of Cristobal. Fees totaling \$5,910 were collected for this special service.

CANAL ZONE FOR ORDERS

Cargo deposited at the docks at Canal Zone ports to be held for orders must be covered by release from the customs authorities, for either delivery into Panama or forwarding to some other country. Releases issued during the year numbered 8,666 at Cristobal and 3,111 at Balboa.

PROHIBITED ALIENS

Chinese passengers arriving at Canal Zone ports during the fiscal year numbered 551, in addition to 3 on hand July 1, 1930, making a total of 554 as compared with 385 for the preceding year. Of this number, 281 were admitted to the Republic of Panama by authority of that Government, and the others, with the exception of 3 who died during the year and 14 awaiting transportation at the end of the year, either proceeded on their journeys or were returned to the port of embarkation. Chinese in transit may be released on bond temporarily and 19 such bonds were accepted at the port of Balboa amounting to \$5,700, and one at Cristobal amounting to \$300.

Chinese in crews of vessels were checked upon arrival and again on departure of vessel in order to see that no illegal landings were made. The crews of 675 vessels were so checked during the year.

SHIPPING COMMISSIONER

The shipping commissioner and his deputies have the same powers as shipping commissioners in the United States ports and American consuls in foreign ports with respect to American seamen. During

the year there were 1,656 seamen shipped on American vessels and 1,333 discharged. Two sick or destitute seamen were returned to the United States at the expense of the appropriation for the relief of destitute seamen, and 203 were signed on vessels as seamen or as workaways and returned to the United States without expense to the Government.

The wages earned by seamen discharged at Canal Zone ports aggregated \$81,261.09; the total approved for deductions on account of advances, allotments, fines, slop-chest accounts, etc., was \$21,653.40, and the balance was either paid to seamen under supervision of the deputy shipping commissioner or received on deposit for the seamen by him. The wages, money, and effects of two American seamen who died in the Canal Zone hospitals, or who died at sea and were brought to the Canal Zone for interment, were handled by the shipping commissioner during the year.

ADMINISTRATION OF ESTATES

The estates of 125 deceased or insane employees of the Panama Canal and the Panama Railroad Co. were settled, as compared with 103 during the preceding fiscal year. Sixteen estates in which cash assets had been received were in course of administration at the end of the fiscal year, and in addition to these 16 there were 44 cases under investigation in which no property or money had yet been received.

LICENSES AND TAXES

Licenses issued for motor vehicles, permits for peddling foodstuffs, the sale of merchandise generally, ships' runners and similar licenses continued to be issued during the year. The total number of such licenses issued numbered 9,571 and the total fees collected therefor amounted to \$51,295.46. This showed an increase over the preceding year of 773 licenses and \$5,691.62 in fees.

The number of motor vehicle licenses and transfers, and miscellaneous licenses issued during the past 10 years, and the aggregate fees, are summarized in this table:

	Motor-vehicles	Motor-vehicle transfers	Bicycle	Miscellaneous	Total	Fees
1922.....	1,892	405	1,403	152	3,852	\$13,735.98
1923.....	2,339	760	930	1,665	5,694	19,335.46
1924.....	2,852	808	1,033	1,374	6,067	22,006.98
1925.....	3,464	1,026	1,024	1,387	6,901	25,061.41
1926.....	4,185	1,192	539	1,562	7,478	30,126.90
1927.....	5,107	1,391	1,074	1,327	8,899	34,731.79
1928.....	5,543	1,490	806	1,070	8,909	36,875.89
1929.....	6,345	1,729	17	1,076	9,167	40,894.39
1930.....	7,280	1,862	1	1,063	10,206	45,603.84
1931.....	8,128	2,083	0	1,443	11,654	51,295.46

IMMIGRATION VISAS

During the year ended June 30, 1931, a total of 39 visas were issued by the executive secretary to alien residents of the Canal Zone going to the United States. Of these, 9 were quota visas, 20 nonquota, and 10 nonimmigrant visas. Fees collected for visas amounted to \$370.

RELATIONS WITH PANAMA

During the year direct correspondence was conducted between the Governments of the Canal Zone and the Republic of Panama with reference to various matters of joint interest, arising from the relations of the Governments and the proximity of their respective areas, and, in addition, concerning several matters of more special nature. One of these was the proposed establishment of a customs and immigration station at Balboa, and another a proposal to establish a customhouse at the village of Paja, on the highway west of the canal, near the Canal Zone boundary.

The improved condition of the highway system of Panama has brought about an increase in trade between the interior towns and the national capital, part of which is in intoxicating liquors. Some correspondence was conducted between the two Governments relative to a modification of the convention of 1924 between the United States and Panama for the prevention of smuggling of intoxicating liquor by including therein the provisions of Article VII of the proposed treaty between the United States and the Republic of Panama, signed July 28, 1926.

Correspondence was also exchanged on the establishment of a free zone at the Atlantic terminal; however, with the change of Government of Panama of January 2, 1931, the matter seems to have been dropped.

COMMERCIAL AVIATION

The number of commercial airways operating in or through the Canal Zone was reduced from four to three inasmuch as the Scadta (Sociedad Colombo Alemana de Transportes Aereos) discontinued its services between the Canal Zone and various points in Colombia on June 15, 1931. This was due to an agreement reached between the Pan American Airways (Inc.) and Scadta whereby the Pan American Airways (Inc.) will now transport the air mail formerly carried by Scadta between the Canal Zone and Colombia and transfer it to Scadta upon its arrival in Colombia. The route flown by the Pan American Airways (Inc.) was therefore changed to include Barranquilla, Colombia, making the route between Cristobal and Miami Cristobal, Barranquilla, Kingston, Cienfuegos, Miami, instead of Cristobal, Kingston, Cienfuegos, Miami.

Another improvement to the air transportation has been the establishment of an air express service between New York and Cristobal for the transportation of valuable packages at rates that compare favorably with those for registered mail.

The project for the construction of a commercial airport on Telfer's Island was revised and submitted. There was included an estimate for the immediate development of a portion of the proposed airport in order to meet the needs of commercial aviation activities in the Canal Zone.

CODIFICATION OF LAWS OF THE CANAL ZONE

The revision and codification of the laws of the Canal Zone was authorized under the provisions of the act of Congress of May 17, 1928. The revision of the laws, in the form of proposals embodying changes in existing laws, with a view to securing congressional authorization prior to submitting new law codes to Congress, was completed during the previous fiscal year and submitted to Congress by the President on June 9, 1930. The proposals for revision were referred to the Committee on Interstate and Foreign Commerce and ordered to be printed during the third session of the Seventy-first Congress. The various bills embodying the recommended changes were reported favorably to Congress by the committee before the close of the session, but because of the press of other legislation no action was taken by Congress. The various bills will be submitted to the Seventy-second Congress which convenes in December, 1931.

SECTION V

FINANCIAL AND STATISTICAL STATEMENTS

Financial statements of major interest relative to the Panama Canal, and tables and several graphs concerned with the traffic through the canal, are presented in this section. The financial statements are abstracted from the annual report of the accounting department, and the traffic tables and graphs were compiled by the bureau of statistics.

The following is a list of all of the tables and bureau reports contained in the annual report of the accounting department and of the three traffic tables. Tables Nos. 34 to 50, inclusive, and reports Nos. 51 to 58, inclusive, in the accounting department report are not published because they are concerned with details of operation which lack general interest. As noted under "Appendixes not printed," following the Table of Contents, the complete report for the accounting department may be consulted at the Washington office of the Panama Canal or at the office of the governor. For purposes of reference, the complete list of the tables and reports is published.

Interspersed among the financial tables are various notes of explanation. Following the financial tables and notes are tables and graphs referring to traffic.

The complete list of tables and bureau reports is as follows:

Table No.

- A. Statement of account, the Panama Canal and United States Treasury—
Cash withdrawals and deposits on account of Panama Canal.

GENERAL BALANCE SHEET AND ANALYSES

ASSETS

1. General balance sheet.
2. Canal fixed property.
3. Canal equipment.
4. Revenue due United States Treasury.
5. Cash receipts and disbursements, United States funds.
6. Accounts receivable outstanding.
- 6-A. Accounts receivable registered.
7. Business property by divisions.
- 7-A. Business fixed property.
- 7-B. Business equipment.
- 7-C. Proportion, general working capital, business divisions.
8. Canal material and supplies on hand.
- 8-A. Material and supplies transactions.
9. United States Treasury.
10. National-defense expenditures.
11. Unclassified expenditures.

LIABILITIES

Table No.

12. Capital liabilities, appropriations by Congress.
13. Accounts payable outstanding.
14. Amortization-depreciation, canal fixed property.
15. Replacement reserves.
16. Repair reserves.
17. Gratuity reserves.
18. Contingent reserves.

OPERATIONS FOR PROFIT AND LOSS

19. Summary of expenses and revenues, current year.
20. Panama Canal surplus account, expenses and revenues to date.
21. Canal expenses and earnings.
22. Canal revenues.
23. Business expenses, revenues, and net profit.

MISCELLANEOUS

24. Balances in appropriation and fund accounting.
25. Status of public works, Panama and Colon.
26. Cost of electric current.
27. Cost of dredging.
28. Receipts and disbursements, Canal Zone funds.
29. Collections of United States funds by collector.
30. Collector's special-deposit account.
31. Money-order business, Canal Zone.
32. Postal-service revenues.
33. Death and injury accidents and payments.

ADDENDA¹

34. Payments by the paymaster.
35. Audited pay rolls.
36. Pay-roll deductions for rent, etc., gold employees.
37. Cost of production of water.
38. Money-order statistics.
39. Postal-service statistics.
40. Clubs and playgrounds, income and expenditures.
41. Clubs and playgrounds, balance sheet.
42. Commissary coupons, issued, etc.
43. Payments account of deaths and injuries.
44. Cost of commissary supplies.
45. Rent collections from nonemployees.
46. Land-rent collections, Panama Railroad.
47. Silver-quarters statistics.
48. Accounts payable registered, Panama Canal.
49. Accounts payable registered, Panama Railroad.
50. Employees bonds.
51. Report of accounting bureau.
52. Report of pay-roll section.
53. Report of personal injury claims.

¹ Omitted from publication, see prefatory notes.

Table No.

54. Report of freight and cargo claims.
55. Report of collections from silver employees.
56. Report of general inspection bureau.
57. Report of time inspection bureau.
58. Report of property inspection bureau.

MOVEMENT OF TRAFFIC THROUGH CANAL

59. Origin and destination of cargo passing through the canal, fiscal year 1931, Atlantic to Pacific.
60. Origin and destination of cargo passing through the canal, fiscal year 1931, Pacific to Atlantic.
61. Statement showing, by nationality, the number of transits of vessels, aggregate Panama Canal net tonnage, tolls assessed, and tons of cargo carried through the Panama Canal from the opening of the canal, August 15, 1914, to June 30, 1924, and by fiscal years ending June 30 from fiscal year 1925 to 1931, inclusive.

PANAMA CANAL OPERATIONS

The major financial results of operations are presented hereinafter in Tables A and Nos. 1 to 33, inclusive.

As explained in these tables, the capital asset accounts on the balance sheet and supporting data are based upon an appraised commercial valuation of the Panama Canal which eliminates \$113,127,337.75 of construction expenditures as chargeable to national defense; also the balance sheet does not take cognizance of accrued compound interest on construction funds and early operating deficits.

The present canal administration considers that the so-called "national defense" capital should be included as a part of the cost of construction of the canal and that accrued interest on construction funds should also be included in the capitalization, the whole to be considered the current capital liability on which the percentage of profit or loss should be reckoned. To this end, the Bureau of Efficiency was invited to collaborate with the accounting department of the Panama Canal in a revision of the capital structure of canal accounts. Two representatives of that bureau arrived on the Isthmus on June 17, 1931, to make a survey. Work on this continued beyond the end of the fiscal year and the results will appear in the next annual report.

In the meantime, in order to present a calculation of the existing capital indebtedness of the Panama Canal, based upon the foregoing principles, the following statement has been prepared. It shows the cash withdrawals and deposits of Panama Canal funds in account with the United States Treasury from the beginning of canal construction to June 30, 1930, with interest compounded annually at 3 per cent. The withdrawals and deposits agree with statistics published in the annual report of the Treasurer of the United States, except that the annual payments of \$250,000 to the Republic of

Panama since 1913 have been added to withdrawals, and dividends of the Panama Railroad paid into the United States Treasury since 1924, amounting in all to \$4,900,000, have been added to deposits, neither of which items is included in the Treasury statement. The statement does not include the cost of fortifications or other military or naval expenditures on the Isthmus, nor treaty payments to the Republic of Colombia.

TABLE A.—*Statement of account, the Panama Canal and United States Treasury cash withdrawals and deposits on account of Panama Canal*

Fiscal year	Withdrawals	Deposits	Net difference	Interest	Total capital liability
1903.....	\$9,985.00		\$9,985.00		\$9,985.00
1904.....	50,164,500.00		50,164,500.00	\$376,233.75	50,550,718.75
1905.....	3,918,819.53	\$371,253.06	3,547,566.77	1,516,521.56	55,614,807.08
1906.....	19,379,373.71	380,680.10	18,998,693.61	1,668,444.21	76,281,944.90
1907.....	27,198,618.71	1,178,949.85	26,019,668.86	2,288,458.35	104,590,072.11
1908.....	38,093,929.04	1,083,761.49	37,010,167.55	3,137,702.16	144,737,941.82
1909.....	31,419,442.41	705,402.42	30,714,039.99	4,342,138.25	179,794,120.06
1910.....	33,911,673.37	3,214,389.48	30,697,283.89	5,393,523.60	215,885,227.55
1911.....	37,038,994.71	1,757,284.44	35,281,710.27	6,476,556.83	257,643,494.65
1912.....	34,285,276.50	2,982,823.92	31,302,452.58	7,729,304.84	296,675,252.07
1913.....	40,167,866.71	4,070,231.27	36,097,635.44	8,900,257.67	341,673,145.08
1914.....	31,702,359.61	698,647.87	31,003,711.74	10,250,194.35	382,927,051.17
1915.....	24,677,107.29	4,130,241.27	20,546,866.02	11,487,811.53	414,961,728.72
1916.....	14,888,194.78	2,869,995.28	12,018,199.50	12,448,851.86	439,428,780.08
1917.....	16,199,262.47	6,150,668.59	10,048,593.88	13,182,863.40	462,660,237.36
1918.....	13,549,762.56	6,414,570.25	7,135,192.31	13,879,807.12	483,675,236.79
1919.....	10,954,409.74	6,777,046.55	4,177,363.19	14,510,257.11	502,362,857.09
1920.....	6,281,463.72	9,039,670.95	¹ 2,758,207.23	15,070,885.71	514,675,535.57
1921.....	16,480,390.79	11,914,361.32	4,566,029.47	15,440,266.07	534,681,831.11
1922.....	3,041,035.40	12,049,660.65	¹ 9,008,625.25	16,040,454.94	541,712,660.80
1923.....	3,870,508.37	17,869,985.25	¹ 13,999,481.88	16,251,409.82	543,965,588.74
1924.....	7,391,711.97	27,124,513.33	¹ 19,732,801.36	16,318,967.66	540,551,755.04
1925.....	9,300,509.73	22,903,732.44	¹ 13,603,222.71	16,216,552.65	543,165,084.98
1926.....	8,669,333.57	24,291,917.87	¹ 15,622,584.30	16,294,955.55	543,837,453.23
1927.....	7,863,376.03	25,894,701.45	¹ 18,031,325.42	16,315,123.59	542,121,251.40
1928.....	10,909,442.27	28,834,345.42	¹ 17,924,003.15	16,263,637.54	540,459,985.79
1929.....	10,220,913.25	28,831,447.24	¹ 18,610,533.99	16,213,799.57	538,063,251.37
1930.....	10,497,935.33	28,971,643.03	¹ 18,473,707.70	16,141,897.54	535,731,441.21
1931.....	10,301,093.83	26,532,668.80	¹ 16,231,574.97	16,071,943.24	535,571,809.48
Total.....	532,387,285.70	307,044,593.59	225,342,692.11	310,229,117.37	535,571,809.48

¹ Indicates excess of deposits over withdrawals.

Based upon the foregoing computations the net interest-bearing capital indebtedness of the Panama Canal at the close of the fiscal year 1931 stands at \$535,571,809.48, which at 3 per cent would call for an annual interest charge of \$16,067,154.27, whereas the net revenue of Panama Canal operations for the fiscal year 1931, as shown in Table No. 19, amounted to \$15,409,991.38, a deficit of \$657,162.89.

OPERATIONS WITH PANAMA RAILROAD CO. FUNDS

The results from the operations of the railroad proper and its various business units on the Isthmus, are shown in detail in the accounts of the Panama Railroad Co., and detailed statement of revenue, expenses, and statistics of all railroad industries, changes in the capital account and the results from the operations of the steamship line will appear in the regular annual report of the Panama

Railroad Co. Only essential data in connection with the operations are shown here.

The operations of the railroad proper, harbor terminals, coal plants, stables, and baggage transfer, were continued throughout the fiscal year, under the direction of the superintendent; the telephone system, under the electrical engineer of the Panama Canal; renting of lands and buildings, under the land agent; and the hotels, commissaries, plantations, dairy farm, and cattle industry, under the chief quartermaster of the Panama Canal.

The net result from all Panama Railroad operations on the Isthmus during the fiscal year 1931 was a profit of \$991,383.72, as compared with \$1,523,874.28 for the preceding year, a decrease of \$532,868.44, or 35 per cent.

TABLES AND NOTES, PANAMA CANAL

The following is the general balance sheet of the Panama Canal at the end of the fiscal year 1931:

TABLE No. 1.—General balance sheet to June 30, 1931

ASSETS		LIABILITIES	
Canal fixed property (Table 2).....	\$240,994,615.25	Commercial capital investment (Table 12).....	\$273,273,818.51
Canal equipment (Table 3)	6,645,444.04	National defense capital investment (Table 12).....	113,127,337.75
Revenue due United States Treasury (Table 4).....	162,254.89	Accounts payable (Table 13).....	1,624,482.42
Cash (Table 5).....	973,252.35	Amortization (unfunded) (Table 14).....	4,013,625.01
Accounts receivable (Table 6).....	738,926.92	Depreciation (unfunded) (Table 14).....	5,867,455.07
Business property (Table 7).....	32,938,450.81	Replacement reserves (funded) (Table 15).....	2,933,276.18
Stores (Table 8).....	4,439,233.33	Repair reserves (funded) (Table 16).....	924,734.45
United States Treasury (Table 9).....	155,737,626.55	Gratuity reserves (funded) (Table 17).....	496,608.74
National defense expenditures (Table 10).....	113,127,337.75	Contingent reserves (funded) (Table 18).....	45,893.94
Undistributed business capital (credit account) (Table 7-C).....	1,808,000.00	Surplus (Table 20).....	151,636,479.91
Unclassified canal expenditures (Table 11).....	15,429.91		
<hr/> Total assets.....	<hr/> 553,943,711.98	<hr/> Total liabilities.....	<hr/> 553,943,711.98

¹ Credit.

The general accounts in above table are explained in further detail under the table numbers listed opposite each item. No change has been made in general accounts designations during the present year.

TABLE NO. 2.—*Detail of canal fixed property, fiscal year 1931*

	Balance, July 1, 1930	Additions	With- drawals	Balance June 30, 1931
Channels:				
Cristobal to Gatun.....	\$11, 636, 700. 00	-----	-----	\$11, 636, 700. 00
Gatun to Pedro Miguel.....	104, 926, 542. 00	-----	-----	104, 926, 542. 00
Pedro Miguel to Balboa.....	18, 032, 612. 00	-----	-----	18, 032, 612. 00
Locks:				
Gatun.....	34, 948, 625. 01	-----	-----	-----
Towing locomotives.....	-----	\$177, 844. 46	-----	35, 126, 469. 47
Pedro Miguel.....	15, 389, 503. 80	-----	-----	15, 389, 503. 80
Miraflores.....	22, 827, 164. 18	-----	-----	22, 827, 164. 18
Spillways:				
Gatun.....	3, 982, 199. 00	-----	-----	3, 982, 199. 00
Miraflores.....	1, 231, 256. 00	-----	-----	1, 231, 256. 00
Floating caisson.....	326, 996. 00	-----	-----	326, 996. 00
Dams:				
Gatun.....	9, 626, 678. 00	-----	-----	9, 626, 678. 00
Gatun-Mindi Levee.....	137, 822. 00	-----	-----	137, 822. 00
Trinidad River.....	65, 057. 00	-----	-----	65, 057. 00
Pedro Miguel.....	423, 070. 00	-----	-----	423, 070. 00
Miraflores.....	1, 136, 594. 00	-----	-----	1, 136, 594. 00
Madden.....	1, 496, 360. 67	1, 279, 605. 86	-----	2, 775, 966. 53
Breakwaters:				
Colon-West.....	4, 189, 810. 00	-----	-----	4, 189, 810. 00
Naos Island.....	995, 337. 00	-----	-----	995, 337. 00
Aids to navigation.....	879, 329. 77	-----	-----	879, 329. 77
Roads, streets, and sidewalks.	1, 217, 635. 14	-----	-----	-----
Thatcher highway.....	-----	238, 070. 52	-----	-----
Miscellaneous.....	-----	19, 038. 31	-----	1, 474, 743. 97
Storm sewers.	235, 346. 30	-----	-----	-----
Miscellaneous.....	-----	7, 022. 81	-----	242, 369. 11
Street-lighting system.	128, 474. 58	-----	-----	-----
Miscellaneous.....	-----	9, 546. 90	-----	138, 021. 48
General buildings:				
Office buildings.....	1, 687, 328. 77	-----	-----	-----
Administration building, Cristobal (final).....	-----	18, 631. 32	-----	1, 705, 960. 09
Storehouses.....	433, 884. 70	-----	-----	-----
Cristobal (part).....	-----	83, 471. 42	-----	517, 356. 12
Weather and hydrographic structures.....	12, 872. 00	-----	-----	12, 872. 00
Health department buildings:				
Gorgas Hospital.....	1, 376, 699. 24	-----	-----	-----
Addition to nurses' quarters (final).....	-----	21, 362. 26	-----	-----
Superintendent's quarters (trans- ferred).....	-----	-----	\$25, 004. 83	1, 373, 056. 67
Colon Hospital.....	191, 630. 00	-----	-----	191, 630. 00
Dispensaries.....	120, 910. 00	-----	-----	120, 910. 00
Asylums.....	410, 181. 21	-----	-----	-----
Palo Seco Leper Colony Building No. 14 (destroyed).....	-----	-----	150. 00	-----
Corozal Hospital Building No. 548 (transferred).....	-----	-----	1, 378. 00	-----
Ward Building.....	-----	133, 219. 55	-----	541, 872. 76
Quarantine stations.....	31, 697. 00	-----	-----	31, 697. 00
Other health department buildings.....	35, 583. 00	-----	-----	35, 583. 00
Cristobal inclinator.....	88, 474. 55	-----	-----	88, 474. 55
Civil government buildings:				
Schoolhouses.....	513, 909. 39	-----	-----	513, 909. 39
Post offices.....	7, 570. 00	-----	-----	-----
Post office, Cristobal (demolished).....	-----	-----	1, 982. 00	5, 588. 00
Fire stations.....	44, 047. 41	-----	-----	-----
Addition to Balboa fire station.....	-----	14, 802. 95	-----	58, 850. 36
Police stations and prisons.....	19, 870. 00	-----	-----	-----
Cristobal police station (demolished).....	-----	-----	3, 000. 00	-----
Gamboa stockade.....	-----	30, 000. 00	-----	46, 870. 00
Courthouses.....	74, 896. 00	-----	-----	-----
Courthouse, Cristobal (transferred).....	-----	-----	9, 450. 00	65, 446. 00
Clubs and playgrounds.....	120, 298. 00	-----	-----	120, 298. 00
Grand total.....	239, 002, 963. 72	2, 032, 616. 36	40, 964. 83	240, 994, 615. 25

The foregoing capital items pertain to the operation of the canal proper. Fixed property used in connection with the operation of the various business activities is listed in Table No. 7-A.

The values shown for most of above items are based on commercial appraisals as of June 30, 1922, but all subsequent additions have been charged to accounts at cost of acquisition. The difference between the appraised value and actual cost value is carried in Table No. 10.

The new administration building, Cristobal, was completed in December, 1930, at a total cost of \$709,915.09.

TABLE No. 3.—*Detail of canal equipment, fiscal year 1931*

	Balance, July 1, 1930	Additions	With- drawals	Balance, June 30, 1931
Floating equipment:				
Tugs.....	\$1,404,306.24			\$1,404,306.24
Supply boats.....	51,544.48			51,544.48
Launches.....	295,183.88			
Bonito, built.....		\$8,035.50		
Cotinga, engine purchased.....		3,596.06		
Owl, built.....		15,862.06		
Swallow, built.....		7,128.01		
Dora "V" surveyed.....			\$1,442.81	328,362.70
Dredges.....	2,325,906.76			2,325,906.76
Barges.....	1,310,120.38			1,310,120.38
Floating cranes.....	659,524.29			659,524.29
Crane boat.....	30,000.00			30,000.00
Grader.....	28,690.30			28,690.30
Drill barges.....	110,000.00			110,000.00
Air-compressor barges.....	95,848.00			95,848.00
Relay barges.....	50,000.00			50,000.00
Ferries.....		216,555.89		216,555.89
Other equipment:				
Road rollers.....	20,348.77			
Transferred.....			20,348.77	
Automobiles.....	2,615.64			
Surveyed.....			1,430.64	1,185.00
Excavator.....	17,370.00			17,370.00
Crane.....	16,030.00			16,030.00
Total.....	6,417,488.74	251,177.52	23,222.22	6,645,444.04

The foregoing equipment is used in the operation of the canal proper. The equipment used in connection with the various business activities of the Panama Canal is listed separately (Table No. 7-B). Only the larger items of canal equipment are capitalized. Small equipment, tools, hospital apparatus, furniture, and fixtures are currently charged to operating expenses; however, strict physical accountability is maintained.

TABLE No. 4.—*Comparative statement of revenue due United States Treasury*

	Fiscal year 1930	Fiscal year 1931
Cash.....	\$187,885.19	\$162,154.89
Outstanding audited bills.....	100.00	100.00
Total.....	187,985.19	162,254.89

Collections for account of miscellaneous receipts form no part of the working capital of the Panama Canal, since these funds must by law be immediately covered into the United States Treasury and relinquished from control of the Panama Canal. These collections consist mainly of tolls, postal receipts, court fees and fines, and amortization of public works in Panama and Colon.

Owing to the above restrictions these items are segregated from cash and accounts pertaining to appropriated funds available for expenditure by canal authorities.

TABLE NO. 5.—Cash receipts and disbursements for account of the United States, fiscal year ended June 30, 1931

CASH RECEIPTS

	United States Treasurer	Disbursing clerk, Wash- ington, D. C.	Paymaster, Canal Zone	Collector, Canal Zone	Total
On hand July 1, 1930, by appropriations and funds:					
Maintenance and operation, Panama Canal.....	\$2,695,083.03	\$250,795.83	\$363,567.01	\$91,677.75	\$3,401,123.62
Sanitation, Canal Zone, Panama Canal.....	38,919.27	3,670.93	42,870.90	7,934.20	93,395.30
Civil government, Panama Canal and Canal Zone.....	131,268.85	22,069.18	43,607.60	3,081.97	200,027.60
Miscellaneous receipts, United States revenues.....	-----	-----	-----	187,885.19	187,885.19
Special deposits.....	-----	-----	-----	463,496.79	463,496.79
Total.....	2,865,271.15	276,535.94	450,045.51	754,075.90	4,345,928.50
Appropriations for fiscal year 1931:					
Maintenance and operation, Panama Canal.....	10,115,225.00	-----	-----	-----	10,115,225.00
Sanitation, Canal Zone, Panama Canal.....	745,000.00	-----	-----	-----	745,000.00
Civil government, Panama Canal and Canal Zone (annual act 1931).....	1,292,915.00	-----	-----	-----	1,292,915.00
Maintenance and operation, Panama Canal.....	47,243.00	-----	-----	-----	47,243.00
Sanitation, Canal Zone, Panama Canal.....	8,900.00	-----	-----	-----	8,900.00
Civil government, Panama Canal and Canal Zone (second deficiency act, fiscal year 1931).....	2,275.00	-----	-----	-----	2,275.00
Total.....	12,211,560.00	-----	-----	-----	12,211,560.00
Transfers between fiscal officers:					
Maintenance and operation, Panama Canal.....	234,072.87	4,800,000.00	12,591,711.40	-----	17,675,784.27
Sanitation, Canal Zone, Panama Canal.....	24,397.78	105,000.00	1,542,603.64	-----	1,672,001.42
Civil government, Panama Canal and Canal Zone.....	6,900.00	60,000.00	1,285,550.61	-----	1,352,450.61
Total.....	315,370.65	4,965,000.00	15,419,865.65	-----	20,700,236.30
Collections:					
Maintenance and operation, Panama Canal.....	135.31	254,703.11	322,234.54	9,747,170.41	10,324,243.37
Sanitation, Canal Zone, Panama Canal.....	40,001.50	23,531.05	-----	837,761.30	901,293.85
Civil government, Panama Canal and Canal Zone.....	-----	7,475.00	3,048.19	84,985.73	95,508.92
Miscellaneous receipts, United States revenues.....	-----	914.35	-----	25,098,589.04	25,099,503.72
Special deposits.....	-----	35,268.60	4,350,411.05	30,341,324.18	34,727,003.83
Total.....	40,136.81	321,892.11	4,675,694.11	66,109,830.66	71,147,553.69
Total cash debits.....	5,432,338.61	5,563,428.05	20,545,605.27	66,863,906.56	108,405,278.49

CASH DISBURSEMENTS

Covered into U. S. Treasury:								
Maintenance and operation (business profits 1930)	\$707,434.78	\$914.35		\$0.33	\$25,124,319.34		\$707,434.78	
Miscellaneous receipts, United States revenues							25,125,234.02	
Total	707,434.78	914.35		.33	25,124,319.34		25,832,668.80	
Transfers between fiscal officers:								
Maintenance and operation, Panama Canal	7,600,000.00	271,710.87					17,675,784.27	
Sanitation, Canal Zone, Panama Canal	805,000.00	24,372.78					1,672,001.42	
Civil government, Panama Canal and Canal Zone	1,260,000.00	6,900.00					1,352,450.61	
Total	9,665,000.00	302,983.65					20,700,236.30	
Disbursements:								
Maintenance and operation, Panama Canal	33,072.55	4,606,064.06					17,506,296.27	
Sanitation, Canal Zone, Panama Canal	478.25	88,467.98					1,665,661.39	
Civil government, Panama Canal and Canal Zone	15.71	66,553.46					1,348,770.55	
Special deposits		35,268.60					34,737,531.72	
Total	34,166.51	4,856,354.10					55,258,258.93	
On hand June 30, 1931:								
Maintenance and operation, Panama Canal	4,800,653.88	367,724.01					5,674,105.94	
Sanitation, Canal Zone, Panama Canal	51,740.80	19,361.22					82,927.76	
Civil government, Panama Canal and Canal Zone	173,843.14	16,090.72					241,955.97	
Appropriated funds, balance \$973,252.35		403,175.95						
Miscellaneous receipts, United States revenues							102,154.89	
Special deposits							452,908.90	
Total	5,025,737.32	403,175.95					6,614,113.46	
Total cash credits	15,432,338.61	5,563,428.05					108,405,278.49	

The Treasurer of the United States advanced to the fiscal officers of the Panama Canal during the fiscal year 1931 the sum of \$9,665,000, and disbursed directly from the Treasury \$34,166.51, a total of \$9,699,166.51. Against this amount the fiscal officers of the Panama Canal remitted to the Treasury the sum of \$315,370.65 and direct collections by the Treasurer amounted to \$40,136.81, a total of \$355,507.46, resulting in a net withdrawal of appropriated funds from the United States Treasury amounting to \$9,343,659.05 as compared with \$9,578,103.26 withdrawn the previous fiscal year.

The sum of \$707,434.78 covering the business profits for the fiscal year 1930 was transferred from the appropriation for maintenance and operation to miscellaneous receipts in the United States Treasury.

TABLE No. 6.—*Comparative statement of accounts receivable outstanding as of June 30, 1931*

	Fiscal year 1930	Fiscal year 1931
Audited bills.....	\$876,623.87	\$704,747.28
Hospital certificates.....	30,662.25	30,722.44
Injury compensation.....	3,127.54	3,449.70
Cement bags returned to contractors.....	19,370.00	-----
Commissary coupons.....	37.50	7.50
Total.....	929,821.16	738,926.92

The above table includes all accounts due the Panama Canal except items pertaining to miscellaneous receipts (Table No. 4), and a few items of utility service, principally for employees, which are not credited to earnings until collected, usually by pay-roll deduction.

TABLE No. 6A.—*Statement of accounts receivable registered*

	Fiscal year 1930	Fiscal year 1931
Repaid to appropriations:		
Panama Railroad Co.....	\$2,979,816.81	\$3,225,180.01
Other departments of the United States.....	2,843,186.67	2,234,317.06
Individuals and companies.....	3,658,861.86	3,331,433.78
Total.....	9,481,865.34	8,790,930.85
Miscellaneous receipts:		
Tolls.....	27,077,407.78	24,646,108.89
Miscellaneous.....	1,250.00	1,200.00
Total.....	27,078,657.78	24,647,308.89
Grand total.....	36,560,523.12	33,438,239.74
Number of bills registered.....	47,224.00	44,202.00

TABLE No. 7.—*Business property by divisions*

	Total	Fixed property	Equipment	Stores	Work in process	Suspense	Undistributed business capital
Electric light and power system.....	\$7,898,264.04	\$7,568,554.47	\$135,707.06	\$24,002.51			\$170,000.00
Electric work.....	104,656.47		21,398.86	9,232.62	\$12,672.43	183,647.44	65,000.00
Telephone, telegraph, and signal work.....	13,141.58		7,226.40	5,915.18			
Water system.....	3,640,672.71	3,484,021.08	22,325.18	13,796.45		1,530.00	125,000.00
Municipal engineering work.....	288,736.85		164,177.47	66,473.51	8,198.98	145,113.11	95,000.00
Public works, Panama.....		1,469,260.45					
Repayments.....		1,639,359.50					
Balance.....	809,906.95	809,906.95					
Public works, Colon.....		1,249,502.71					
Repayments.....		1,572,013.84					
Balance.....	677,483.87	677,483.87					
Shops and dry docks.....	1,462,839.97	264,733.98	343,581.60	22,323.34	378,515.00	3,631.05	450,000.00
Steamships.....	1,200,000.00	1,200,000.00					
Docks, wharves, and piers.....	2,368,200.26	2,368,200.26					
Coaling plants.....	500,000.00	500,000.00					
Colliers and coal barges.....	2,614,616.00	2,614,616.00					
Fuel-oil plants.....	1,833,165.17	1,649,985.17	5,678.93	96,177.56		1,323.51	80,000.00
Business storehouses.....	1,883,471.42	383,471.42					500,000.00
Animal and motor transportation.....	619,844.90	22,995.73	551,848.17				45,000.00
Motor car repair shop.....	68,602.02	17,723.87	21,818.83	15,729.76		329.56	13,000.00
Building repairs and construction.....	368,288.21	11,600.00	57,666.34	17,537.00	13,312.48	18,082.39	250,000.00
Panama Canal press.....	276,143.18	161,000.00	17,939.68	79,605.30	2,598.20		15,000.00
Gold quarters.....	5,752,033.82	5,752,033.82					
Silver quarters.....	447,071.52	635,693.85					
Rented buildings.....	476,820.10	449,140.03	27,679.87		.20	118,622.33	
District quartermasters' supplies.....	9,288.70		5,943.93	2,878.97		465.80	
Hotel Tivoli.....	234,711.90	162,054.40	72,657.60			18,160.80	
Farm bureau.....	18,811.04		4,349.76			2,211.05	
Madden Dam division.....	2,211.05						
Marine salvage section.....	23,967.72		23,077.77	888.95			
Sand and gravel.....	159,990.60			159,990.60			
Nautical charts and publications.....	429.30			1,988.98	.83	11,510.01	
Fortification division.....	1,703.54					1,703.54	
Total business property.....	32,838,450.81	28,763,355.90	1,483,077.35	516,498.73	415,297.62	147,778.79	1,808,000.00

1 Credit.

In order to maintain a statistical comparison of the individual net earnings of the various business units with an interest rate of 3 per cent on the capital investment, as shown in Table No. 23, the entire investment in each business activity, consisting of fixed property, equipment, accounts receivable, and cash, has been consolidated as above under the heading of "Business Property." Further details of this investment are shown in Tables 7-A, 7-B, and 7-C. The undistributed business capital charged to the various divisions is made up of an arbitrary portion of the general store stock (representing the estimated value of standard material and supplies held in reserve for these divisions); cash estimated as sufficient to conduct normal operations; and average outstanding accounts receivable (See Table No. 7-C).

TABLE NO. 7-A.—*Detail of business fixed property, fiscal year 1931*

	Balance July 1, 1930	Additions	With- drawals	Balance June 30, 1931
Hydroelectric plant, Gatun.....	\$1,662,456.79			\$1,662,456.79
Miraflores power plant.....	1,524,416.92			1,524,416.92
Substations.....	1,860,574.35			1,860,574.35
Transmission system.....	1,355,733.38			1,355,733.38
Distribution lines.....	1,147,524.60			
Miscellaneous.....		\$17,848.43		1,165,373.03
Total, electrical division.....	7,550,706.04	17,848.43		7,568,554.47
Zone-Panama water system.....	1,842,509.46			1,842,509.46
Zone-Colon water system.....	819,487.36			819,487.36
Zone water system.....	812,720.89			
Testing laboratory, Miraflores.....		6,488.48		
Water lines, new quarters.....		2,814.89		822,024.26
Total, municipal engineering division.....	3,474,717.71	9,303.37		3,484,021.08
Waterworks and sewers, Panama.....	876,353.22			876,353.22
Pavements.....	592,913.23			592,913.23
Total, public works, Panama.....	1,469,266.45			1,469,266.45
Less repayments.....	628,655.53		\$30,703.97	659,359.50
Balance.....	840,610.92		30,703.97	809,906.95
Waterworks and sewers, Colon.....	623,883.68			623,883.68
Pavements.....	625,619.03			625,619.03
Total, public works, Colon.....	1,249,502.71			1,249,502.71
Less repayments.....	546,335.07		25,683.77	572,018.84
Balance.....	703,167.64		25,683.77	677,483.87
Cristobal dry dock.....	50,000.00			50,000.00
Balboa roundhouse, sand house, water tank.....	111,500.00			111,500.00
Balboa car and paint shop.....	95,000.00			95,000.00
Miscellaneous buildings.....	8,283.98			8,283.98
Total, shops and dry docks.....	264,783.98			264,783.98
Steamships:				
Ancon.....	600,000.00			600,000.00
Cristobal.....	600,000.00			600,000.00
Total, steamships.....	1,200,000.00			1,200,000.00
Pier 18, Balboa.....	1,168,200.26			1,168,200.26
Pier 6, Cristobal.....	1,200,000.00			1,200,000.00
Total, docks, wharves, and piers.....	2,368,200.26			2,368,200.26
Cristobal coaling plant.....	500,000.00			500,000.00

TABLE NO. 7-A.—*Detail of business fixed property, fiscal year 1931*—Continued

	Balance July 1, 1930	Additions	With- drawals	Balance June 30, 1931
Colliers.....	\$1,014,616.00			\$1,014,616.00
Coal barges.....	1,600,000.00			1,600,000.00
Total, colliers and barges.....	2,614,616.00			2,614,616.00
Fuel-oil plant, Balboa.....	670,898.56			
2 additional tanks.....		\$40,635.01		
Additional pipe lines.....		146,601.23		858,134.80
Fuel-oil plant, Cristobal.....	739,695.50			
2 additional tanks.....		35,355.50		
Additional pipe lines.....		16,799.37		791,850.37
Total, fuel-oil plants.....	1,410,594.06	239,391.11		1,649,985.17
Business storehouses.....	300,000.00			
Storehouse and office buildings, Cristobal (part).....		83,471.42		383,471.42
Animal and motor transportation.....	19,694.59			
Storage shed, Cristobal.....		3,302.14		22,996.73
Motor-car repair shop.....	16,358.32			
Repair shed, Balboa.....		1,365.55		17,723.87
Building repairs and construction.....	11,690.00			11,690.00
Panama Canal press.....	161,000.00			161,000.00
Gold quarters.....	5,630,117.32			
New quarters, Cristobal district.....		54,166.98		
New quarters, Balboa district.....		37,401.46		
Miscellaneous extensions.....		5,565.23		
Transferred.....		32,382.83		
Demolished.....			\$7,600.00	5,752,033.82
Silver quarters.....	677,593.85			
Transferred.....			6,000.00	
Demolished.....			5,900.00	665,693.85
Rented buildings.....	428,152.87			
Garage stalls.....		11,537.16		
Lodge halls.....		9,450.00		449,140.03
Hotel Tivoli.....	162,054.40			162,054.40
Grand total.....	28,334,057.96	505,185.68	75,887.74	28,763,355.90

Some of above items are based on appraised commercial valuations as of June 30, 1922, but all subsequent additions have been charged to capital account at cost of acquisition. The difference between the appraised valuation and actual cost of original property is carried in Table No. 10.

TABLE NO. 7-B.—*Detail of business equipment, fiscal year 1931*

	Balance July 1, 1930	Additions	With- drawals	Balance June 30, 1931
Electric light and power system:				
Machinery and tools.....	\$10,056.51			\$10,056.51
Electric ranges.....		\$117,913.03		117,913.03
Electric heaters.....		7,737.52		7,737.52
Electric work:				
Machinery and tools.....	17,934.57			17,934.57
Automobiles.....	3,944.55		\$480.26	3,464.29
Telephone, telegraph, and signal work, machinery and tools.....	7,226.40			7,226.40
Water system, machinery and tools.....	22,325.18			22,325.18
Municipal engineering work:				
Machinery and tools.....	104,781.57	29,313.63		134,095.20
Road rollers (transferred).....		30,082.27		30,082.27
Shops and dry docks, machinery and tools.....	343,581.60			343,581.60
Fuel-oil plants, machinery and tools.....	5,678.93			5,678.93
Animal and motor transportation:				
Machinery and tools.....	10,408.27			10,408.27
Automobiles.....	484,507.63	111,023.58	56,892.52	538,638.69
Mules.....	2,801.21			2,801.21
Motor-car repair shop, machinery and tools.....	21,818.83			21,818.83
Building repairs and construction, machinery and tools.....	52,751.54	4,914.80		57,666.34
Panama Canal press, machinery and tools.....	17,939.68			17,939.68

TABLE NO. 7-B.—*Detail of business equipment, fiscal year 1931—Continued*

	Balance July 1, 1930	Additions	With- drawals	Balance June 30, 1931
Rented buildings, restaurants, machinery and tools.....	\$27,679.87	-----	-----	\$27,679.87
District quartermasters' supplies, machinery and tools.....	5,943.93	-----	-----	5,943.93
Hotel Tivoli, machinery and tools.....	74,185.00	-----	\$1,527.50	72,657.50
Farm bureau:				
Machinery and tools.....	1,145.50	-----	-----	1,145.50
Mules.....	1,086.76	-----	-----	1,086.76
Launch La Garza ¹	2,117.50	-----	-----	2,117.50
Marine-salvage section:				
Machinery and tools.....	17,927.77	-----	-----	17,927.77
Barges.....	5,150.00	-----	-----	5,150.00
Grand total.....	1,240,992.80	\$300,984.83	58,900.28	1,483,077.35

¹ Name changed from Kariger.

The foregoing equipment is used in connection with the operation of the various business activities of the Panama Canal. The equipment used in the operation of the canal proper is listed in Table No. 3.

TABLE NO. 7-C.—*Business property by divisions, proportion of general working capital by divisions*

Division	Accounts receivable	Working cash	Stores	Total
Electric light and power system.....	\$50,000	\$20,000	\$100,000	\$170,000
Electric work.....	5,000	10,000	50,000	65,000
Water system.....	45,000	30,000	50,000	125,000
Municipal engineering work.....	25,000	20,000	50,000	95,000
Shops and dry docks.....	100,000	100,000	250,000	450,000
Fuel-oil plants.....	75,000	5,000	-----	80,000
Business storehouses.....	250,000	-----	250,000	500,000
Animal and motor transportation.....	15,000	10,000	20,000	45,000
Motor-car repair shop.....	-----	3,000	10,000	13,000
Building repairs and construction.....	25,000	25,000	200,000	250,000
Panama Canal Press.....	10,000	5,000	-----	15,000
Total.....	600,000	228,000	980,000	1,808,000

The above represents the estimated proportion of accounts receivable, working cash, and stores, charged to business divisions, as shown in last column of Table No. 7. This duplication of assets is deducted on the balance sheet, Table No. 1.

TABLE NO. 8.—*Comparative statement of canal material and supplies, June 30, 1931*

	Fiscal year 1930	Fiscal year 1931
Balboa store.....	\$3,035,634.98	\$2,854,267.19
Medical store.....	81,722.71	62,489.93
Administration building store.....	19,400.23	24,608.02
Paraiso store.....	523,605.83	554,334.87
Cristobal store.....	617,660.87	582,421.46
Locks store.....	506,936.74	606,639.26
District quartermasters' stores:		
Balboa.....	1,900.72	-----
Pedro Miguel.....	200.34	-----
Gatun.....	103.66	-----
Cristobal.....	276.47	-----
Total.....	2,481.19	-----
Invoices in suspense.....	1,302.99	1,578.60
Material drawn by divisions not yet charged to work.....	23,710.67	16,757.75
Total.....	4,810,850.23	4,700,030.78
Less reserves for stores adjustments.....	411,489.98	260,797.45
Book value of stores on hand.....	4,399,360.25	4,439,233.33

¹ Credit.

The foregoing table shows the book value of general store stock, but does not include the value of additional stock carried by business divisions, as shown in 4th column of Table No. 7, amounting to \$516,498.73, which makes a total book value of all stores of \$4,955,-732.06. This figure, plus the items of "Invoices in suspense," and "Reserve for stores adjustments," as shown in above table, equals the balance of Table No. 8-A.

TABLE No. 8-A.—*Statement of material and supplies received, issued, and sold—
all stores—during fiscal year ended June 30, 1931*

Stock on hand July 1, 1930.....			\$5,200,675.09
Standard stock.....		\$5,116,669.02	
Scrap and obsolete.....		84,006.07	
Received during the year:			
By purchase.....	\$4,054,765.59		
Direct to divisions.....	1,155,155.24		
		5,209,920.83	
By manufacture—			
Mechanical division.....	273,134.69		
Panama Canal Press.....	9,702.36		
Miscellaneous.....	66,337.05		
		349,174.10	
			5,559,094.93
Total.....			10,759,770.02
Issued and sold during the year:			
Issued—			
To business divisions.....	3,020,667.79		
To canal divisions.....	1,653,947.85		
		4,674,615.64	
Sold.....		1,149,276.94	
Empty containers returned, etc.....		28,090.25	
Adjustments.....		112,837.90	
			5,739,144.93
On hand July 1, 1931.....			5,020,625.09
Standard stock.....		4,959,523.22	
Scrap and obsolete.....		61,101.87	
Drawn by divisions not yet charged to work:			
Business divisions.....	180,725.27		
Canal divisions.....	16,757.75		
			197,483.02
Grand total.....			5,218,108.11

¹ Credit.

The foregoing table covers transactions for all stores at stock card prices, exclusive of the invoices in suspense and reserve for stores adjustments shown in Table No. 8.

TABLE No. 9.—*Comparative statement United States Treasury*

	Fiscal year, 1930	Fiscal year, 1931
Appropriations.....	\$2,865,271.15	\$5,025,737.32
Capital refundments.....	140,352,228.85	153,973,337.65
Theoretical interest.....	1,403,045.29	1,662,080.10
Capital and surplus adjustments.....	¹ 2,623,853.46	¹ 3,392,870.40
Reserves loaned to appropriations.....	¹ 1,754,913.75	¹ 1,754,913.75
Defense capital adjustments.....	224,255.63	224,255.63
Total.....	140,466,033.71	155,737,626.55

¹ Credit.

All revenues covered into the United States Treasury and relinquished from control of the Panama Canal are debited to capital

refundments, which account is credited to the debit of appropriations for such portion of these deposits as may be authorized for current expenditure in the annual appropriations by the Congress for the Panama Canal.

Theoretical interest is credited to amortization and depreciation of canal fixed property, based on calculation of final amortization of the capital investment in the Panama Canal in 100 years. These reserves may not be withheld from tolls revenue covered into the United States Treasury and invested in interest-bearing securities, but this accounting expedient gives the same effect.

The credit in capital and surplus adjustments represents the value of property replacements financed from replacement reserve funds and added to property asset accounts prior to actual withdrawal of the replaced property. The credit will be used to absorb the book value of the replaced property on its final retirement.

Reserves loaned to appropriations represent the amount of replacement reserve funds released to supplement appropriations for current expenses. The credit will be used to absorb the book value of the corresponding property upon final retirement, or will be restored to replacement reserves if the corresponding replacement funds are subsequently appropriated by the Congress.

Defense capital adjustments represent the expenditure for purposes of national defense from current appropriations for canal operation.

TABLE NO. 10.—*National defense expenditures to June 30, 1931*

Defense capital expenditures to June 30, 1931.....\$113, 127, 337. 75

For details see Table 14 in the annual report for the fiscal year 1927. No change in fiscal year, 1931.

This account represents the difference between actual construction cost of the Panama Canal and its fair commercial valuation based upon appraisal calculations made in 1922, as directed by the Secretary of War in letter to the governor dated October 18, 1921.

This account does not include the cost of fortifications or maintenance of the military establishments on the Isthmus, such expenditures being covered by appropriations for the Army and Navy, which form no part of this report.

TABLE NO. 11.—*Statement of unclassified expenditures*

	Fiscal year			Fiscal year	
	1930	1931		1930	1931
Executive department.....	\$989. 13	-----	Port captain, Balboa.....	\$750. 00	\$332. 51
Civil government.....	1 35, 472. 60	1 346, 626. 35	Port captain, Cristobal.....	316. 22	308. 22
Health department.....	2, 843. 61	1 20, 418. 48	Lighthouse subdivision.....	1 8, 398. 74	-----
Meteorology and hydrog- raphy.....	1 2, 000. 00	-----	Atlantic locks.....	16, 848. 12	-----
Balboa store.....	1 13, 514. 03	1 5, 453. 53	Pacific locks.....	1 7, 940. 51	-----
Cristobal store.....	-----	685. 44	Dredging division.....	52, 333. 88	53, 387. 00
District quartermaster, Cristobal.....	65. 00	-----	General accounts.....	1 1, 119. 11	12, 355. 28
			Total.....	35, 700. 97	1 5, 429. 91

1 Credit.

The above accounts represent various items in suspense covering advance charges and credits that could not properly be cleared before closing the books for the fiscal year.

TABLE No. 12.—*Statement of appropriations by the Congress (capital liability)*

Net canal construction appropriations to June 30, 1931.....		\$386,910,301.00
Total appropriations.....	\$387,069,143.31	
Less amounts returned to surplus fund, U. S. Treasury to June 30, 1931.....	158,842.31	
Panama Canal fund.....	\$130,852.65	
Canal connecting Atlantic and Pacific Oceans.....	27,989.66	
(For details see Annual Report, 1924.)		
19 annual payments of \$250,000 each to the Republic of Panama, including act of Apr. 18, 1930, for payment due Feb. 26, 1931.....		4,750,000.00
Maintenance and operation (detailed below).....		135,464,733.12
Total appropriations.....		527,125,034.12

DETAILS OF OPERATING APPROPRIATIONS

	Maintenance and operation	Sanitation, Canal Zone	Civil govern- ment, Pan- ama Canal, and Canal Zone	Increase of compensa- tion, Pan- ama Canal	Total
Act of—					
Mar. 3, 1915.....	\$5,200,000.00	\$700,000.00	\$540,000.00	-----	\$6,440,000.00
July 1, 1916.....	5,750,000.00	700,000.00	600,000.00	-----	7,050,000.00
June 3, 1917.....	9,000,000.00	700,000.00	700,000.00	-----	10,400,000.00
July 12, 1917.....	-----	-----	-----	\$10,006.22	10,006.22
June 4, 1918.....	-----	150,000.00	-----	-----	150,000.00
July 1, 1918.....	9,000,000.00	900,000.00	750,000.00	-----	10,650,000.00
July 3, 1918.....	-----	-----	-----	16,000.00	16,000.00
Mar. 1, 1919.....	-----	-----	-----	32,592.66	32,592.66
July 19, 1919.....	7,547,939.00	850,000.00	702,000.00	-----	9,099,939.00
Nov. 4, 1919.....	-----	-----	150,000.00	-----	150,000.00
May 29, 1920.....	-----	-----	-----	34,500.00	34,500.00
June 5, 1920.....	7,531,851.00	850,000.00	900,000.00	-----	9,281,851.00
Mar. 1, 1921.....	-----	-----	24,670.00	-----	24,670.00
Mar. 4, 1921.....	7,250,000.00	850,000.00	900,000.00	21,500.00	9,021,500.00
June 30, 1922.....	2,659,434.00	525,000.00	930,000.00	16,800.00	4,131,234.00
Mar. 2, 1923.....	5,079,683.00	575,000.00	930,000.00	17,520.00	6,602,203.00
June 7, 1924.....	5,748,160.00	580,000.00	912,000.00	-----	7,240,160.00
Dec. 6, 1924.....	103,050.00	6,266.00	79,670.00	-----	188,986.00
Feb. 12, 1925.....	7,140,000.00	653,216.00	942,150.00	-----	8,735,366.00
Apr. 15, 1926.....	5,986,094.00	670,000.00	999,980.00	-----	7,656,074.00
Feb. 23, 1927.....	5,830,000.00	670,000.00	1,100,000.00	-----	7,600,000.00
Mar. 23, 1928.....	6,832,000.00	670,000.00	1,158,000.00	-----	8,660,000.00
May 29, 1928.....	-----	-----	10,000.00	-----	10,000.00
Mar. 4, 1929.....	-----	52,000.00	4,400.00	-----	56,400.00
Feb. 23, 1929.....	8,000,000.00	820,000.00	1,191,000.00	-----	10,011,000.00
Mar. 26, 1930.....	-----	-----	10,000.00	-----	10,000.00
May 28, 1930.....	9,615,225.00	745,000.00	1,292,915.00	-----	11,653,140.00
July 3, 1930.....	500,000.00	-----	-----	-----	500,000.00
Mar. 4, 1931.....	47,245.00	8,900.00	2,275.00	-----	58,420.00
	108,820,681.00	11,675,382.00	14,829,060.00	148,918.88	135,474,041.88
Less amount transferred to surplus fund, U. S. Treas- ury.....	-----	-----	1,553.78	7,754.98	9,308.76
Total.....	108,820,681.00	11,675,382.00	14,827,506.22	141,163.90	135,464,733.12
Appropriation for fiscal year 1932 (act of Feb. 23, 1931).....	9,359,808.00	782,189.00	1,351,689.00	-----	11,493,686.00
Act of Feb. 23, 1931, annual payment to the Republic of Panama due Feb. 26, 1932.....	-----	-----	-----	-----	250,000.00

¹ Codification Canal Zone laws.

The total commercial capital investment and national defense capital investment in the Panama Canal as shown on the general balance sheet, Table 1, amounting to \$386,401,156.26, represents the total funds advanced from the United States Treasury for construction of the canal. It does not include the cost of capital additions subsequent to 1922, as the cost of such additions has been offset by

canal revenues deposited in the United States Treasury, and they are therefore considered to have been financed from earnings.

This total capital liability for construction funds advanced (exclusive of interest) is being extinguished by the accumulating balance carried as capital refundments, Table 9, representing canal revenues deposited in the United States Treasury in excess of annual appropriations for maintenance.

The actual net construction appropriations, as indicated in the foregoing table, amount to \$386,910,301 whereas the total liability as stated above amounts to \$386,401,156.26, a difference of \$509,144.74, which covers diversions between construction and operating appropriations prior to 1922, the date upon which construction liability was set up.

The annual payments to the Republic of Panama, made through the Department of State, are not included in canal accounting.

All current appropriations for the Panama Canal are carried in the United States Treasurer's Account Table 9, until funds are actually withdrawn by canal fiscal officers.

TABLE NO. 13.—*Comparative statement of accounts payable outstanding as of June 30, 1931*

	Fiscal year 1930	Fiscal year 1931
United States invoices.....	\$166,497.08	\$336,013.39
Isthmus vouchers.....	149,813.20	142,589.52
Current pay rolls.....	1,151,699.56	1,107,952.33
Unpaid salaries and wages.....	25,520.27	31,930.15
Drums, carboys, and reels.....	2,608.23	5,995.98
Local purchases.....	110,922.44	1.05
Total.....	1,485,216.60	1,624,482.42

¹ Debit.

The above table covers all current obligations of the Panama Canal, except deposits to guarantee payment of bills, which funds are not included in the balance-sheet assets, but are covered by Table No. 5.

TABLE NO. 14.—*Amortization-depreciation canal fixed property (unfunded)*

	Fiscal year 1930	Fiscal year 1931
Amortization:		
Charged to operating expenses.....	\$3,150,000.00	\$3,500,000.00
Theoretical interest.....	406,917.49	513,625.01
Total (Table 1).....	3,556,917.49	4,013,625.01
Depreciation:		
Charged to operating expenses.....	4,081,448.66	4,718,999.98
Theoretical interest.....	996,127.80	1,148,455.09
Total (Table 1).....	5,077,576.46	5,867,455.07
Amortization and depreciation (combined):		
Charged to operating expenses.....	7,231,448.66	8,218,999.98
Theoretical interest (Table 9).....	1,403,045.29	1,662,080.10
Total.....	8,634,493.95	9,881,080.08

The amortization accruals plus interest are calculated to extinguish the investment in certain items of canal fixed property, such as channels, excavations and fills, locks, dams, breakwaters and certain concrete structures, within the 100-year period of their estimated life.

Depreciation accruals plus interest are calculated to extinguish the investment in the balance of items of canal fixed property in 100 years, as well as to cover replacements in the interim.

Above figures do not include appropriated funds reserved for replacement of canal equipment and business property shown under Table 15.

TABLE No. 15.—*Detail of replacement reserves (funded)*

	Fiscal year 1930	Fiscal year 1931
Canal equipment:		
Tugs.....	\$315,653.38	\$675,032.38
Supply boats.....	32,331.60	34,731.60
Launches.....	109,789.28	98,440.39
Dredges.....	125,744.21	78,655.79
Barges.....	550,022.40	318,286.32
Crane boat.....	12,320.00	14,000.00
Graders.....	28,690.30	28,690.30
Drill barges.....	55,760.01	66,009.93
Air compressor barge.....	142,703.00	137,619.56
Relay barges.....	18,750.24	21,875.28
Road rollers.....	5,366.29
Automobiles.....	1,260.13	861.60
Excavators.....	10,422.00	12,159.00
Cranes.....	1,157.65	2,226.25
Reserve equipment.....	175.20	201.90
Total canal equipment.....	1,073,251.27	1,313,551.18
Business fixed property:		
Electric light and power system.....	557,438.11	468,456.17
Water system.....	410,576.28	336,390.62
Dry docks.....	39,166.67	44,166.67
Collars and barges.....	47,031.25	66,234.65
Fuel oil plants.....	166,858.10	219,054.35
Animal and motor transportation.....	11,861.44	2,430.46
Motor car repair shop.....	9,723.86	9,759.35
Building repairs and construction.....	9,228.18	56,397.34
Panama Canal Press.....	8,388.04	4,304.00
Gold quarters.....	16,510.71	38,435.50
Rented buildings.....	54,043.42	69,457.72
Hotel Tivoli.....	16,164.73	31,882.57
Total business fixed property.....	1,323,969.37	1,346,969.40
Business equipment:		
Machinery and tools—		
Electric light and power system.....	63,920.11	10,550.13
Electric work.....	7,586.93	11,530.96
Telephone, telegraph, and signal work.....	4,987.79	8,055.96
Water system.....	10,715.07	16,090.31
Municipal engineering work.....	95,073.65	90,624.72
Shops and dry docks.....	15,226.50	9,780.03
Fuel oil plants.....	4,653.46	4,479.62
Animal and motor transportation.....	60,411.46	6,143.61
Motor car repair shop.....	4,056.61	1,824.14
Building repairs and construction.....	9,111.80	17,935.16
Panama Canal Press.....	28,263.26	30,287.89
Rented buildings.....	12,869.78	15,547.92
District quartermasters' supplies.....	9,115.12	8,023.36
Hotel Tivoli.....	18,526.68	25,744.74
Farm bureau.....	2,100.51	1,095.60
Marine salvage section.....	17,079.84	17,689.73
Total machinery and tools.....	333,245.57	272,755.60
Total business fixed property and equipment.....	1,657,214.94	1,619,725.00
Grand total.....	2,730,466.21	2,933,276.18

1 Debit.

The foregoing table covers the amount of funds available for the replacement of canal equipment and business fixed property and equipment. It does not cover amortization and depreciation of canal fixed property (Table No. 14) which is theoretically charged into the accounts, but for which no actual cash reserve is maintained.

During the year there was added to the replacement reserve by charges into operations and proceeds of sales \$1,100,425.26.

There were used from this replacement reserve the following amounts in round numbers: Electrical division shop, battery-charging station, and office building (part), \$141,500; electric ranges and water heaters, \$125,500; motor-vehicle replacements, \$111,500; fuel-oil line extensions and gasoline tanks, \$103,000; Corozal Reservoir (part), \$69,500; quarters, \$68,500; water-storage tanks, \$35,000; water lines for Albrook Field, \$34,000; launches, \$32,000; garages, \$11,500; miscellaneous machinery and tools, \$104,500; miscellaneous water system improvements, \$28,000; electrical division improvements, \$18,000; other business division improvements, \$15,000; leaving a balance at the end of the fiscal year of \$2,933,276.18.

Against the combined reserves available for repairs and replacements at the end of June, 1931, amounting to \$3,858,010.63, as shown in the foregoing table and in Table No. 16, the following amounts have already been obligated: Fuel-oil plant improvements, \$200,000; new tug, \$191,250; Cristobal shop improvements, \$150,000; water-storage tank at Mount Hope, \$150,000; new quarters, \$120,000; electrical division shop, battery-charging station, and office building, \$102,500; supervisory remote control for three electrical division substations, \$70,000; sawmill and repair shops, \$46,000; Corozal Reservoir, \$50,000; launches, \$35,000; electric ranges and water heaters, \$32,000; garages, \$10,000; replacement of motor vehicles, \$56,500; reroofing storehouse lumber shed, \$20,000; miscellaneous business improvements, \$28,100; and miscellaneous business equipment, \$107,700; total of \$1,369,050; leaving only \$2,488,960.63, of which approximately \$1,000,000 is continuously obligated for periodic overhauling and extraordinary repairs to equipment in constant use.

TABLE No. 16.—*Detail of repair reserves (funded)*

	Fiscal year 1930	Fiscal year 1931
Canal property:		
Equipment—		
Tugs.....	\$56,786.19	\$99,603.93
Supply boats.....	11,555.36	19,114.03
Launches.....	57,311.09	68,955.64
Dredges.....	163,298.50	141,931.36
Barges.....	239,532.80	290,920.73
Crane boat.....	121,952.43	848.54
Graders.....	5,831.57	7,268.85
Drill barges.....	148,453.96	169,998.68
Air-compressor barge.....	3,995.06	5,291.16
Relay barges.....	148,971.21	140,758.12
Road rollers.....	1418.70	
Total equipment.....	178,806.55	211,084.66

TABLE NO. 16.—*Detail of repair reserves (funded)*—Continued

	Fiscal year 1930	Fiscal year 1931
Business property:		
Fixed property—		
Electric light and power system.....	\$46, 149. 01	\$49, 276. 78
Shops and dry docks.....	103, 868. 90	157, 371. 92
Fuel-oil plants.....	267, 769. 58	350, 614. 06
Business storehouses.....	152, 380. 90	19, 096. 23
Panama Canal Press.....		604. 84
Hotel Tivoli.....	2, 696. 05	2, 696. 05
Farm bureau.....	84. 98	
Total fixed property.....	368, 187. 62	551, 467. 42
Equipment:		
Municipal engineering work.....	20, 989. 59	21, 927. 68
Shops and dry docks.....	101, 878. 80	89, 190. 00
Building repairs and construction.....	13, 790. 93	14, 593. 57
Panama Canal Press.....		641. 97
Farm bureau.....	486. 91	95. 95
Marine salvage section.....	15, 801. 05	35, 925. 10
Total equipment.....	151, 973. 46	162, 182. 37
Total business property.....	520, 161. 08	713, 649. 79
Grand total.....	698, 967. 63	924, 734. 45

¹ Debit.

The foregoing table covers the amount of funds available for extraordinary repairs and overhaul of canal equipment and business fixed property and equipment.

On July 1, 1930, the reserve for extraordinary repairs amounted to \$698,967.63, to which was added during the year \$1,173,498.84, making a total of \$1,872,466.47. Expenditures of \$947,732.02 were made from this amount during the year as follows: Regular repairs, \$868,711.02; improvements to Cristobal shops, \$79,021; leaving a balance on June 30, 1931, of \$924,734.45. (For obligations against the combined balance of replacement and repair reserves, see remarks under Table No. 15.)

TABLE NO. 17.—*Detail of gratuity reserves (funded)*

	Fiscal year 1930	Fiscal year 1931
Electrical division.....	\$111, 110. 38	\$116, 367. 67
Municipal engineering work.....	66, 956. 26	53, 821. 90
Mechanical division, shops and dry docks.....	272, 963. 92	256, 097. 15
Building repairs and construction division.....	58, 453. 00	43, 687. 54
Madden Dam division.....	6, 217. 01	6, 440. 40
Fortification division.....	21, 136. 32	20, 194. 08
Total.....	536, 836. 89	496, 608. 74

The foregoing represents the amount of cash held in reserve for vacation pay due employees of the principal business divisions. This fund is created by adding a percentage to the direct gold labor charges for work performed by the divisions listed above to the credit of this account. The account is debited with the amount paid to employees when leave is actually taken or when leaving the service.

TABLE No. 18.—*Detail of contingent reserves (funded)*

	Fiscal year 1930	Fiscal year 1931
Operation and maintenance.....	\$45,588.33	\$45,570.27
Sanitation.....		174.60
Civil government.....	150.57	149.07
Total.....	45,738.90	45,893.94

The amounts shown in above table represent credits from unclaimed wages and other vouchers, usually of small amounts, and are used to absorb uncollectible accounts and other minor losses.

TABLE No. 19.—*Summary of expenses and revenues*

	1930	1931
CANAL OPERATIONS		
Canal expenses.....	\$12,502,933.40	\$12,892,390.29
Depreciation-amortization, fixed property.....	992,337.68	992,633.32
Gross canal expenses.....	13,495,321.08	13,885,073.61
Canal earnings.....	4,151,400.15	3,741,720.08
Net canal expenses.....	9,343,920.93	10,143,353.53
Canal revenues.....	27,426,372.71	24,990,580.74
Net canal revenues.....	18,082,451.78	14,847,227.21
Fixed capital charge.....	7,456,319.89	7,512,922.19
Surplus or deficit.....	10,626,131.89	7,334,305.02
BUSINESS OPERATIONS		
Business revenues.....	19,865,895.45	17,774,467.46
Business expenses.....	19,104,923.79	17,211,703.29
Net business revenues.....	760,971.66	562,764.17
Fixed capital charge.....	808,861.93	836,574.88
Surplus or deficit.....	147,890.27	1273,810.71
COMBINED CANAL AND BUSINESS OPERATIONS		
Panama Canal revenues.....	47,292,268.16	42,765,048.20
Panama Canal expenses.....	28,448,844.72	27,355,056.82
Net revenues.....	18,843,423.44	15,409,991.38
Fixed capital charge.....	8,265,181.82	8,349,497.07
Surplus or deficit.....	10,578,241.62	7,060,494.31

¹ Deficit.

Canal earnings consist of sales and services which by law are repaid to appropriation for canal maintenance, and hence are deducted from appropriation expenditures.

Canal revenues consist principally of tolls, and by law must be covered into the United States Treasury as miscellaneous receipts.

No capital interest is charged against the Panama Canal by the United States Treasury, but for statistical comparison a theoretical capital interest charge at 3 per cent, the rate at which most of the Panama Canal bonds were sold, is included in above table, based on an appraised commercial investment in the Panama Canal, amounting to between \$270,000,000 and \$275,000,000 according to fluctuating investments in working capital. The balance of construction cost of the Panama Canal, amounting to approximately \$113,000,000 is shown on Table 10, making the total construction cost of the Panama Canal, exclusive of the military and naval establishments, approximately \$385,000,000.

TABLE No. 20.—Comparison of expenses, revenues and surplus to date

CANAL OPERATIONS

	Tolls	Licenses, fees, postal re- ceipts, etc.	Total canal revenues	Net canal expenses	Net revenues (surplus)
1914.....	\$14,618.68	-----	\$14,618.68	\$166,030.91	¹ \$151,412.23
1915.....	4,343,383.69	-----	4,343,383.69	4,123,128.09	220,255.60
1916.....	2,399,830.42	\$158,711.93	2,558,542.38	6,990,750.15	¹ 4,411,207.77
1917.....	5,631,781.66	176,617.04	5,808,398.70	6,788,047.60	¹ 979,648.90
1918.....	6,264,765.71	147,077.57	6,411,843.28	5,920,342.94	491,500.34
1919.....	6,156,118.95	197,898.03	6,354,016.98	6,112,194.77	241,822.21
1920.....	8,493,082.56	442,789.01	8,935,871.57	6,548,272.43	2,387,599.14
1921.....	11,261,919.31	778,197.39	12,040,116.70	9,328,300.14	2,711,816.56
Total.....	44,565,500.98	1,901,291.00	46,466,791.98	45,986,067.03	480,724.95
To business surplus.....	-----	480,724.95	480,724.95	-----	480,724.95
1922.....	44,565,500.98	1,420,566.05	45,986,067.03	45,986,067.03	-----
1923.....	11,193,383.47	192,208.85	11,385,592.32	7,919,017.63	3,466,574.69
1924.....	17,507,630.52	184,213.54	17,691,844.06	7,690,777.56	10,001,066.50
1925.....	24,289,603.16	392,250.73	24,681,853.89	8,373,905.39	16,307,948.50
1926.....	21,374,664.12	207,954.04	21,582,618.16	8,116,693.44	13,465,924.72
1927.....	22,927,456.03	217,680.50	23,145,136.53	7,993,468.47	15,151,668.06
1928.....	24,217,185.32	391,623.50	24,608,808.82	8,997,715.02	15,611,093.80
1929.....	26,943,513.11	232,532.57	27,176,045.68	8,951,200.82	18,224,844.86
1930.....	27,123,534.33	243,391.39	27,366,925.72	9,637,150.71	17,729,775.01
1931.....	27,077,117.36	349,255.35	27,426,372.71	9,343,920.93	18,082,451.78
1931.....	24,644,550.39	346,030.35	24,990,580.74	10,143,353.53	14,847,227.21
Total.....	271,864,138.79	4,177,706.87	276,041,845.66	133,153,270.53	142,888,575.13

BUSINESS OPERATIONS

	Business revenues	Business expenses	Net revenues (surplus)
1914.....	\$690,298.32	\$695,720.71	¹ \$5,422.39
1915.....	2,135,074.92	2,191,475.70	¹ 56,400.78
1916.....	6,488,521.61	6,476,623.17	11,898.44
1917.....	7,579,588.44	7,540,160.78	39,427.66
1918.....	10,324,071.91	10,317,912.35	6,159.56
1919.....	13,684,881.18	13,623,853.92	61,027.26
1920.....	14,705,371.82	14,465,685.69	239,686.13
1921.....	15,232,317.08	14,668,105.88	564,211.20
Total.....	70,840,125.28	69,979,536.20	860,587.08
Expense carried in canal operation above.....	-----	379,862.13	¹ 379,862.13
Net revenues carried to surplus.....	70,840,125.28	70,359,400.33	480,724.95
Interest on public works, Panama and Colon, etc., not included in net revenues in prior years.....	619,584.59	-----	619,584.59
Adjustment status June 30, 1921.....	71,459,709.87	70,359,400.33	1,100,309.54
1922.....	7,747,227.57	7,423,998.41	323,259.16
1923.....	10,872,543.36	9,732,200.86	1,140,642.50
1924.....	12,968,777.29	12,067,153.17	901,624.12
1925.....	14,564,114.93	13,798,198.08	765,916.85
1926.....	15,874,478.01	15,033,167.72	841,310.29
1927.....	15,878,654.57	15,002,117.77	876,536.80
1928.....	16,929,247.24	16,192,527.81	736,719.43
1929.....	17,236,785.02	16,498,934.76	737,850.26
1930.....	19,865,895.45	19,104,923.79	760,971.66
1931.....	17,774,467.46	17,211,703.29	562,764.17
Total.....	221,172,200.77	212,424,295.99	8,747,904.78

COMBINED OPERATIONS

	Revenues	Expenses	Surplus
Canal operations.....	\$276,041,845.66	\$133,153,270.53	\$142,888,575.13
Business operations.....	221,172,200.77	212,424,295.99	8,747,904.78
Total.....	497,214,046.43	345,577,566.52	151,636,479.91

¹ Deficit.

The foregoing table covers the net profit from Panama Canal operations since the opening of the canal for commercial traffic in 1914.

The expenses do not include interest on the capital investment; but canal operating expenses include an annual charge for amortization and depreciation from 1922 to date, amounting at the end of the fiscal year 1931 to \$3,500,000 and \$4,718,999.98, respectively, or a total of \$8,218,999.98. (See Table No. 14.)

TABLE NO. 21.—*Statement of canal earnings, expenses, and net expenses*

	Fiscal year 1931		Net canal expenses
	Canal expenses	Earnings	
Executive department:			
Executive offices.....	\$384,091.18	\$136,614.19	\$247,476.99
Cables and radiograms.....	208.10	44.30	163.80
General executive expenses.....	189.75	-----	189.75
Shipping commissioner.....	48,974.73	-----	48,974.73
Canal Record.....	18,809.60	167.42	18,642.18
Land office.....	2,400.00	-----	2,400.00
Law books.....	518.06	-----	518.06
Railroad motor cars.....	110.50	-----	110.50
Clubs and playgrounds.....	236,361.26	109,836.26	126,525.00
Total.....	691,663.18	246,662.17	445,001.01
Accounting department:			
Accounting office.....	468,972.49	310,668.44	158,304.05
Paymaster's office.....	50,561.82	29,942.42	20,619.40
Collector's office.....	53,109.33	37,483.50	15,625.83
Total.....	572,643.64	378,094.36	194,549.28
Washington office:			
Chief of office.....	51,956.99	-----	51,956.99
Purchasing bureau.....	202,841.61	40,518.14	162,323.47
Assistant auditor's office.....	28,556.16	-----	28,556.16
Disbursing clerk's office.....	8,505.26	-----	8,505.26
Total.....	291,860.02	40,518.14	251,341.88
Civil government:			
Civil affairs.....	21,229.57	-----	21,229.57
Customs.....	31,088.52	234.00	30,854.52
Posts.....	206,939.24	11,545.50	195,393.74
Schools.....	414,346.04	14,531.06	399,814.98
Fire protection.....	133,021.57	144.43	132,877.14
Police and prisons.....	455,255.93	66,328.14	388,927.79
District court.....	31,793.00	-----	31,793.00
Codification Canal Zone laws.....	16.00	-----	16.00
District attorney.....	14,927.20	-----	14,927.20
Marshal.....	9,830.29	-----	9,830.29
Magistrates' courts.....	19,335.34	-----	19,335.34
Total.....	1,337,782.70	92,783.13	1,244,999.57
Health department:			
Chief health officer.....	39,547.52	2,379.23	37,168.29
Gorgas Hospital.....	723,557.35	409,072.60	314,484.75
Colon Hospital.....	149,624.50	98,612.28	51,012.22
Dispensaries.....	89,246.62	28,218.21	61,028.41
Corozal Hospital.....	183,731.94	176,583.23	7,148.71
Palo Seco Colony.....	39,664.25	21,039.25	18,625.00
Medical store.....	8,142.32	-----	8,142.32
Quarantine service.....	74,943.03	28,926.12	46,016.91
Sanitation, Panama.....	42,437.14	9,707.48	32,729.66
Street cleaning and garbage collection, Panama.....	82,745.35	66,680.25	16,065.10
Sanitation, Colon.....	24,696.92	1,664.11	23,032.81
Street cleaning and garbage collection, Colon.....	58,153.64	45,555.82	12,597.82
Sanitation, Canal Zone.....	160,551.16	50,767.93	109,783.23
Total.....	1,677,041.74	942,211.51	734,830.23
Technical divisions:			
Office engineer.....	110,640.37	91,451.56	19,188.81
Meteorology and hydrography.....	51,385.26	8,527.53	42,857.73
Surveys.....	65,208.24	23,804.15	41,404.09
Total.....	227,233.87	123,783.24	103,450.63

TABLE NO. 21.—Statement of canal earnings, expenses, and net expenses—Contd.

	Fiscal year 1931		Net canal expenses
	Canal expenses	Earnings	
Storehouses—general:			
Balboa store.....	\$347,521.28	\$183,602.46	\$163,918.82
Administration building store.....	8,107.68	1.00	8,106.68
Paraiso store.....	35,342.50	6,600.00	28,742.50
Cristobal store.....	141,396.35	40,678.47	100,717.88
Total.....	532,367.81	230,881.93	301,485.88
Public buildings and grounds:			
Chief quartermaster's office.....	41,986.37	33,798.43	8,187.94
District quartermaster, Balboa.....	248,824.09	120,645.91	128,178.18
District quartermaster, Pedro Miguel.....	52,284.81	35,134.58	17,150.23
District quartermaster, Gatun.....	35,794.91	24,844.32	10,950.59
District quartermaster, Cristobal.....	94,494.35	33,149.84	61,344.51
Total.....	473,384.53	247,573.08	225,811.45
Municipal expenses:			
Street lighting.....	20,398.34	—	20,398.34
Water for municipal purposes.....	23,400.00	—	23,400.00
Roads, streets, and sidewalks.....	98,143.87	—	98,143.87
Storm sewers.....	20,996.13	—	20,996.13
Operation, Pedro Miguel ferry.....	69,863.68	—	69,863.68
Total.....	232,802.02	—	232,802.02
Miscellaneous general expenses:			
Railroad tracks, maintenance.....	23,386.50	—	23,386.50
Recruiting and repatriating employees.....	17,177.04	—	17,177.04
Transportation of employees on Isthmus.....	120,000.00	—	120,000.00
Compensation, injured employees.....	600.00	—	600.00
Maintenance, laborers' quarters.....	94,886.56	—	94,886.56
Commercial airport survey.....	1,393.60	—	1,393.60
Total.....	257,443.70	—	257,443.70
Marine division:			
Marine superintendent.....	9,816.83	—	9,816.83
Port captain, Balboa.....	130,846.88	9,563.89	121,282.99
Port captain, Cristobal.....	70,678.43	2,040.72	68,637.71
Admeasurement of vessels.....	45,355.49	1,160.00	44,195.49
Inspection of vessels.....	8,056.54	4,080.90	3,975.64
Pilotage—			
Balboa.....	192,154.29	99,106.31	93,047.98
Cristobal.....	210,879.35	219,300.00	8,420.65
Tugs, launches, and other floating equipment—			
Balboa.....	250,884.96	189,555.55	61,329.41
Cristobal.....	238,719.55	218,458.29	20,261.26
Handling lines—			
Balboa.....	130,132.36	135,383.42	5,251.06
Cristobal.....	125,264.12	130,336.00	5,071.88
Aids to navigation.....	225,169.86	30,984.37	194,185.49
Total.....	1,637,958.66	1,039,909.45	597,989.21
Locks, operation and maintenance:			
Gatun Locks—			
Superintendence.....	45,353.20	—	—
Operation.....	377,868.93	—	—
Maintenance.....	96,637.18	—	—
Overhaul.....	687,503.72	—	—
Total, Gatun Locks.....	1,207,363.03	305.73	1,207,057.30
Pedro Miguel Locks—			
Superintendence.....	20,902.90	—	—
Operation.....	253,675.82	—	—
Maintenance.....	116,353.38	—	—
Total, Pedro Miguel Locks.....	390,932.10	1,736.36	389,195.74
Miraflores Locks—			
Superintendence.....	38,593.27	—	—
Operation.....	306,612.82	—	—
Maintenance.....	164,399.35	—	—
Total, Miraflores Locks.....	509,605.44	—	509,605.44
Locks store, Miraflores.....	6,450.01	—	6,450.01
Total locks.....	2,114,350.58	2,042.09	2,112,308.49

TABLE No. 21.—*Statement of canal earnings, expenses, and net expenses—Contd.*

	Fiscal year 1931		Net canal expenses
	Canal expenses	Earnings	
Gatun Dam, maintenance.....	\$62,481.93	\$12,611.98	\$49,869.95
Gatun spillway.....	2,800.94		2,800.94
Damage to vessels in locks.....	12,906.69		12,906.69
Damage to vessels in canal.....	39,488.96		39,488.96
Channel maintenance:			
Atlantic entrance.....	35,361.30		
Gatun Lake.....	77,356.20		
Gaillard Cut.....	916,247.91		
Miraflores Lake.....	456.38		
Pacific entrance.....	952,847.53		
Cristobal Harbor.....			
Balboa Harbor.....	283,103.96		
Removal of floating obstructions.....	41,013.35		
Floating cranes, maintenance.....	58,145.08		
Dredging division work.....	363,647.61	384,589.00	120,941.39
Total channel maintenance.....	2,728,179.32	384,589.00	2,343,590.32
Total.....	12,892,390.29	3,741,720.08	9,150,670.21
Amortization.....	350,000.00		350,000.00
Depreciation.....	642,683.32		642,683.32
Grand total.....	13,885,073.61	3,741,720.08	10,143,353.53

¹ Earnings exceed expenses.

The earnings of the divisions engaged in the transiting of vessels through the canal, as well as earnings of sanitation and civil government divisions, are deducted from gross expenses to arrive at the net expenditures from canal appropriations.

Approximately \$128,000 of executive office earnings, and \$355,000 of accounting department earnings represent proportional charges against business divisions of the Panama Canal and the Panama Railroad Co. Business divisions are reimbursed for their proportional expense by adding a surcharge to the direct cost on all work performed. The Panama Railroad's proportion is distributed to the various units of that organization.

The Government's contribution to the operation and maintenance of clubs and playgrounds is \$126,525. All expense in excess of this amount is paid from receipts and profits from the operation of the clubhouses.

The earnings of the purchasing bureau of the Washington office and general storehouses on the Isthmus include \$40,000 and \$208,500, respectively, charged against business storehouse operations to cover purchasing, inspection, and handling of material used by business divisions or sold to outside interests, which expense is recovered through surcharges added to the price of material.

The earnings of the dredging division, amounting to \$384,500 include \$241,000 for the Panama Railroad fill at Colon; \$82,000 for France Field fill for the United States Army and \$21,000 for Chame sand for Panama Canal stock. The balance is covered by miscellaneous jobs and use of floating equipment.

TABLE NO. 22.—*Statement of canal revenues*

	Fiscal year 1930	Fiscal year 1931
Tolls.....	\$27, 077, 117. 36	\$24, 644, 550. 39
Postal receipts.....	261, 183. 41	257, 061. 52
Licenses, fees, fines, etc.....	76, 966. 81	80, 054. 15
Interest.....	9, 132. 41	8, 000. 00
Miscellaneous.....	1, 972. 72	914. 68
Total.....	27, 426, 372. 71	24, 990, 580. 74

The revenues shown in the above table are exclusive of the net profits from business operations shown in Table No. 23, which will be covered into the United States Treasury as miscellaneous receipts, and the earnings shown in Table No. 21, which are repaid to appropriations.

TABLE NO. 23.—*Statement of business expenses, revenues, and profit and loss, fiscal year 1931*

	Fiscal year 1931		Profit or loss	Fixed capital charge 3 per cent per annum
	Expenses	Revenues		
Electric light and power system.....	\$582, 893. 87	\$827, 214. 96	\$244, 321. 09	\$233, 592. 83
Electrical work.....	750, 525. 33	775, 561. 54	25, 036. 21	3, 434. 79
Water system.....	527, 174. 47	553, 312. 27	26, 137. 80	87, 391. 28
Municipal engineering work.....	1, 147, 474. 97	1, 161, 926. 22	14, 451. 25	9, 073. 81
Public works, Panama.....	300, 138. 53	331, 550. 70	31, 412. 17	² 31, 412. 17
Public works, Colon.....	166, 504. 36	187, 175. 10	20, 670. 74	² 20, 670. 74
Shops and dry docks.....	3, 282, 211. 80	3, 332, 211. 64	49, 999. 84	49, 959. 45
Docks, wharves, and piers.....	65, 314. 38	84, 121. 70	18, 807. 32	71, 046. 00
Handling fuel oil.....	483, 522. 08	510, 236. 70	26, 714. 62	47, 466. 37
Business storehouses, including fuel oil.....	4, 092, 213. 38	4, 137, 842. 79	45, 629. 41	25, 252. 08
Animal and motor transportation.....	529, 513. 57	527, 530. 09	¹ 1, 983. 48	18, 030. 49
Motor car repair shop.....	210, 797. 68	226, 058. 96	15, 261. 28	2, 006. 61
Building repairs and construction.....	2, 020, 728. 10	2, 041, 807. 26	21, 079. 16	12, 286. 29
Panama Canal press.....	231, 314. 22	236, 634. 70	5, 320. 48	8, 122. 99
Gold quarters.....	465, 082. 17	493, 583. 39	28, 501. 22	169, 339. 47
Silver quarters.....	223, 143. 41	223, 143. 41	-----	19, 760. 32
Rented buildings.....	58, 510. 56	88, 479. 28	29, 968. 72	14, 010. 96
District quartermasters' supplies.....	241, 313. 34	254, 198. 81	12, 885. 47	-----
Hotel Tivoli.....	22, 935. 90	30, 000. 00	7, 064. 10	7, 064. 10
Farm bureau.....	37, 401. 43	28, 093. 44	¹ 9, 307. 99	130. 44
Madden Dam division.....	1, 279, 605. 86	1, 279, 605. 86	-----	-----
Marine salvage section.....	117, 238. 67	56, 476. 85	¹ 60, 761. 82	744. 21
Sand and gravel.....	92, 006. 95	102, 674. 95	10, 668. 00	5, 767. 65
Nautical charts and publications.....	1, 275. 27	2, 163. 85	888. 58	11. 83
Fortification division.....	282, 862. 99	282, 862. 99	-----	-----
Grand total.....	17, 211, 703. 29	17, 774, 467. 46	³ 562, 764. 17	\$36, 574. 88

¹ Loss.² Figured at 2 per cent in accordance with contract.

³ Profits on public works, Panama and Colon, amounting to \$52,082.91, have been included in quarterly remittances to the United States Treasurer, covering interest and amortization collections from the Republic of Panama. The balance of the \$562,764.17 net profits above after deducting the \$52,082.91, already remitted, which balance amounts to \$510,681.26 will be immediately covered into the United States Treasury as miscellaneous receipts, United States revenues, in accordance with regulations.

The profit on business operations for the fiscal year 1930 amounted to \$760,971.66, compared with \$562,764.17 shown in the above table.

Business operations of the Panama Canal are conducted separately from operating activities pertaining directly to the transiting of vessels, and government of the Canal Zone. The annual appropriation acts for the Panama Canal authorize the use of appropriated funds for the

conduct of auxiliary business activities, provided that funds so advanced are recovered through earnings, and repaid to appropriations; and with the further proviso that any net profit derived from such business activities be covered annually into the United States Treasury as miscellaneous receipts (except for public works, Panama and Colon, profits on these operations being remitted quarterly by special regulation).

The total expense of operation and maintenance of "silver quarters" was \$256,694.45, which is approximately \$33,500 more than the expenses shown in above table, which have been reduced to equal the revenue collected, and the difference has been charged to allotment for "Maintenance of laborers' quarters," as shown in Table 21, this latter account also being charged with the cost of extraordinary repairs not included in the operating expenses of "silver quarters."

The loss in "animal and motor transportation" was caused by a \$27,000 reduction in revenues over 1930, due principally to the completion of the Madden Road and changes in rates.

The loss in "Farm bureau" activities was caused by \$3,500 expense in completing the irrigation system at Summit experimental gardens and a general decline in revenues.

The "Marine salvage section" is maintained for protection of shipping in the canal and adjacent waters in connection with aids to navigation, but this section does not enter into competition with commercial salvage companies, and consequently revenues do not ordinarily equal expenses.

TABLE NO. 24.—*Balances in appropriation and fund accounting ledger, June 30, 1931*

	United States Treasury appropriations	Cash on hand	Accounts receivable	Transfers available	Work in process and suspense items	Storehouse stock	Total
Assets:							
Maintenance and operation.....	\$4,800,653.88	\$873,452.06	\$622,143.69	\$59,745.28	\$429,133.75	\$4,888,492.48	\$11,673,621.14
Sanitation.....	51,740.30	31,187.46	110,686.33	-----	20,418.48	67,239.58	240,435.19
Civil government..	173,343.14	68,612.83	6,096.90	-----	146,626.35	-----	201,426.52
Total appropriations.....	5,025,737.32	973,252.35	738,926.92	59,745.28	362,088.92	4,955,732.06	12,115,482.85
Miscellaneous receipts.....	-----	162,154.89	100.00	510,681.26	-----	-----	672,936.15
Trust funds.....	-----	452,968.90	-----	-----	-----	-----	452,968.90
Total.....	5,025,737.32	1,588,376.14	739,026.92	570,426.54	362,088.92	4,955,732.06	13,241,387.90

¹ Credit.

TABLE No. 24.—*Balances in appropriation and fund accounting ledger, June 30, 1931—Continued*

	Working capital allotment	Water revenue due miscellaneous receipts	Accounts payable	Transfers payable	General ledger reserves	Balance	Total
Liabilities:							
Maintenance and operation.....	\$4,265,000.00	\$26,784.78	\$1,398,920.26	\$510,681.26	\$4,400,189.64	\$1,072,045.20	\$11,673,621.14
Sanitation.....	100,000.00	-----	117,109.90	15,761.02	174.60	7,389.67	240,435.19
Civil government.....	10,000.00	-----	108,452.26	43,984.26	149.07	38,840.93	201,426.52
Total appropriations.....	4,375,000.00	26,784.78	1,624,482.42	570,426.54	4,400,513.31	1,118,275.80	12,115,482.85
Miscellaneous receipts.....	-----	-----	672,936.15	-----	-----	-----	672,936.15
Trust funds.....	-----	-----	452,968.90	-----	-----	-----	452,968.90
Total.....	4,375,000.00	26,784.78	2,750,387.47	570,426.54	4,400,513.31	1,118,275.80	13,241,387.90

	Disbursing clerk	Paymaster	Collector	Total
Fiscal officers, detail:				
Maintenance and operation.....	\$367,724.01	\$470,953.29	\$34,774.76	\$873,452.06
Sanitation.....	19,361.22	8,759.38	3,066.86	31,187.46
Civil government.....	16,090.72	50,005.02	2,517.09	68,612.83
Total appropriations.....	403,175.95	529,717.69	40,358.71	973,252.35
Miscellaneous receipts.....	-----	-----	162,154.89	162,154.89
Trust funds.....	-----	-----	452,968.10	452,968.90
Total.....	403,175.95	529,718.49	655,481.70	1,588,376.14

This table shows the status of Panama Canal working capital by the various appropriations and funds by which it is separately accountable under existing laws and Treasury regulations.

A revolving fund of \$4,375,000 is reserved to cover the net investment in store stock and current accounts. Cash to meet the total amount of funded reserves is also set aside, and the balance indicates the amount available for expenditure for operation and maintenance to be added to the appropriations for the ensuing fiscal year, as shown at the foot of Table 12. The balance of \$1,118,275.80 shown in the foregoing table covers principally uncompleted construction projects to be carried forward to 1932, which includes \$720,000 for Madden Dam; \$132,000 for towing locomotives; \$66,500 for Corozal Hospital ward; and \$45,000 for Thatcher Highway and ferries.

TABLE No. 25.—*Status of public works in cities of Panama and Colon, June 30, 1931*

	Total	Panama	Colon
Construction cost:			
Waterworks and sewers.....	\$1,500,236.90	\$876,353.22	\$623,883.68
Pavements.....	1,218,532.26	592,913.23	625,619.03
Total.....	2,718,769.16	1,469,266.45	1,249,502.71
Maintenance, operation and repairs (including proportion of Zone system).....	4,715,894.92	2,798,616.44	1,917,278.48
Interest at 2 per cent per annum:			
Waterworks and sewers.....	521,447.22	292,516.37	228,930.85
Pavements.....	420,917.74	219,599.42	201,318.32
Zone system.....	341,302.87	230,108.55	111,194.32
Total.....	1,283,667.83	742,224.34	541,443.49
Total payable from water rentals.....	8,718,331.91	5,010,107.23	3,708,224.68

TABLE No. 25.—*Status of public works in cities of Panama and Colon, June 30, 1931—Continued*

	Total	Panama	Colon
Water rentals and deficit payments:			
Maintenance, operation and repairs.....	\$4, 715, 894. 92	\$2, 798, 616. 44	\$1, 917, 278. 48
Interest.....	1, 283, 667. 83	742, 224. 34	541, 443. 49
Proportion of capital cost.....	1, 231, 378. 34	659, 359. 50	572, 018. 84
Total.....	7, 230, 941. 09	4, 200, 200. 28	3, 030, 740. 81
Capital cost reimbursable June 30, 1931:			
Waterworks and sewers.....	836, 292. 89	488, 399. 86	347, 893. 03
Pavements.....	651, 097. 93	321, 507. 09	329, 590. 84
Total.....	1, 487, 390. 82	809, 906. 95	677, 483. 87
Total payable from water rentals.....	8, 718, 331. 91	5, 010, 107. 23	3, 708, 224. 68

The Panama Canal supplies water to the cities of Panama and Colon from the Canal Zone system, and maintains the sewers and streets in the two cities under a contract entered into between the Panama Canal and the Republic of Panama in 1907. The Panama Canal collects the water rentals from the residents of these two cities and uses the funds to cover the cost of the water and maintenance of sewers and streets, interest on the unamortized investment at 2 per cent per annum and amortization based on 50 years from 1907. Interest on the investment amounting to \$1,283,667.83 and \$1,231,378.34 repaid on the capital cost have been covered into the United States Treasury as miscellaneous receipts.

TABLE No. 26.—*Detail of cost of production and distribution of electric current*

	Fiscal year 1930	Fiscal year 1931
Gatun hydroelectric generating station:		
Operation and maintenance.....	\$40, 690. 21	\$39, 817. 68
Division and general expense.....	15, 595. 51	14, 345. 94
Reserve for depreciation.....	24, 959. 40	24, 959. 40
Reserve for repairs.....	2, 400. 00	2, 400. 00
Total cost.....	83, 645. 12	81, 523. 02
Net kilowatt-hours generated.....	59, 638, 902	59, 496, 495
Unit cost.....	\$0. 0014	\$0. 0014
Miraflores Diesel electric generating station: ¹		
Operation and maintenance.....	\$57, 935. 42	\$46, 990. 68
Division and general expense.....	12, 987. 67	11, 944. 16
Reserve for depreciation.....	22, 863. 00	22, 863. 00
Reserve for repairs.....	3, 000. 00	3, 000. 00
Total cost.....	96, 786. 09	84, 797. 84
Net kilowatt-hours generated.....	4, 960, 900	5, 822, 000
Operation of substations:		
Balboa.....	\$18, 222. 67	\$17, 769. 86
Cristobal.....	17, 175. 34	17, 679. 09
Gatun.....	19, 528. 10	17, 162. 58
Miraflores.....	23, 743. 63	25, 655. 58
Summit.....	716. 96	5, 438. 76
Gamboa.....	3, 933. 70	2, 242. 40
Division and general expense.....	29, 021. 91	27, 293. 60
Reserve for depreciation.....	27, 908. 64	27, 908. 64
Reserve for repairs.....	1, 500. 00	1, 500. 00
Total cost.....	141, 750. 95	142, 650. 51
Transmission lines:		
Inspection and maintenance.....	\$20, 353. 32	\$18, 119. 99
Division and general expense.....	5, 048. 26	5, 218. 49
Reserve for depreciation.....	20, 336. 04	20, 336. 04
Reserve for repairs.....	4, 980. 00	4, 980. 00
Total cost.....	50, 717. 62	48, 654. 52

¹ The Miraflores Diesel generating station is operated as a reserve station. The power supplied by this station is for dry season water conservation, peak loads, abnormal conditions on high tension lines, and for test purposes. During the fiscal year 1930 the plant was operated for a total of 2,407 engine hours, while during the fiscal year 1931 it was operated for a total of 2,536 engine hours.

TABLE NO. 26.—*Detail of cost of production and distribution of electric current—Continued*

	Fiscal year 1930	Fiscal year 1931
Distribution lines:		
Inspection, maintenance and alterations.....	\$156,755.11	206,879.33
Division and general expense.....	1,483.53	1,168.88
Reserve for depreciation.....	17,096.46	17,219.77
Total cost.....	175,335.10	225,267.98
Grand total cost of distributed power.....	\$548,234.88	\$582,893.87
Total net kilowatt-hours (including line loss).....	64,599,802	65,318,495
Unit cost exclusive of capital charges.....	\$0.0085	\$0.0089

TABLE NO. 27.—*Statement of cost of dredging, fiscal year 1931*

	Atlantic entrance	Gatun Lake	Gaillard Cut	Pacific entrance	Balboa Harbor	Total
YARDAGE						
Quantities excavated:						
Dipper dredges—						
Earth.....		118,850	353,000	62,250	82,400	646,500
Rock.....		99,150	1,028,900	335,650	108,550	1,572,250
Total.....		218,000	1,381,900	427,900	190,950	2,218,750
Suction dredges—						
Earth.....	281,000			4,624,200	2,102,900	7,008,100
Rock.....				359,000	51,100	410,100
Total.....	281,000			4,983,200	2,154,000	7,418,200
Total yardage.....	281,000	218,000	1,381,900	5,411,100	2,344,950	9,636,950
COST						
Operation:						
Dredging, dipper—						
Dipper dredges.....		\$29,216.43	\$250,941.45	\$88,997.36	\$42,492.82	\$411,648.06
Tugs and barges.....		31,020.90	295,103.99	76,346.10	34,799.98	437,270.97
Hydraulic graders.....			12,777.72			12,777.72
Air compressor barges.....			18,613.88			18,613.88
Drill barges.....				268,448.64		268,448.64
Drilling.....			41,422.87			41,422.87
Blasting.....			39,544.76			39,544.76
Sluicing.....			8,768.37			8,768.37
General expense.....		11,836.68	152,387.51	96,991.40	11,549.09	272,764.68
Total, dipper dredging.....		72,074.01	819,560.55	530,783.50	88,841.89	1,511,259.95
Cost per cubic yard.....		.3306	.5931	1.2404	.4653	.6811
Dredging, suction—						
Suction, dredges.....	20,436.96			175,920.95	97,113.43	293,471.34
Pipe lines.....	4,864.65			58,548.80	55,387.36	118,800.81
Dykes.....				25,558.04	652.62	26,210.66
General expense.....	7,285.50			38,139.52	22,884.18	88,309.20
Total, suction dredging.....	32,587.11			318,167.31	176,037.59	526,792.01
Cost per cubic yard.....	.1160			.0638	.0817	.0710
Total, dredging expense.....	32,587.11	72,074.01	819,560.55	848,950.81	264,879.48	2,038,051.96
Total, cost per cubic yard.....	.1160	.3306	.5931	.1569	.1130	.2115

TABLE NO. 28.—*Receipts and disbursements by collector of Canal Zone funds*

FISCAL YEAR 1930		FISCAL YEAR 1931	
Cash on hand, July 1, 1929.....	\$881,203.85	Cash on hand, July 1, 1930.....	\$864,787.55
Receipts:		Receipts:	
Clubhouse funds.....	\$368,957.00	Clubhouse funds.....	\$497,664.84
Trust funds.....	33,960.12	Trust funds.....	23,890.31
Money-order funds.....	1,603,770.87	Money-order funds.....	2,080,876.59
Interest.....	24,304.23	Interest.....	24,292.74
Air mail funds.....	24,467.73		
	2,055,459.95		2,626,724.88
Total.....	2,936,663.80	Total.....	3,491,512.43
Disbursements:		Disbursements:	
Clubhouse funds.....	378,780.98	Clubhouse funds.....	509,929.74
Trust funds.....	24,006.10	Trust funds.....	26,566.05
Money-order funds.....	1,599,931.02	Money-order funds.....	1,921,311.64
Interest.....	22,300.65	Interest.....	19,591.38
Air mail funds.....	46,857.50		
	2,071,876.25		2,477,398.81
Cash on hand, June 30, 1930.....	864,787.55	Cash on hand, June 30, 1931.....	1,014,113.62
Clubhouse funds.....	118,696.15	Clubhouse funds.....	106,431.25
Trust funds.....	18,565.20	Trust funds.....	15,889.46
Postal savings.....	181.00	Postal savings.....	181.00
Money-order funds.....	715,784.80	Money-order funds.....	875,350.15
Interest.....	11,560.40	Interest.....	16,261.76

TABLE NO. 29.—*Statement of collections made by collector repaid to appropriations and collections deposited to miscellaneous receipts during fiscal year ended June 30, 1931*

MAINTENANCE AND OPERATION, PANAMA CANAL		MAINTENANCE AND OPERATION, PANAMA CANAL— continued	
Collections credited to earnings:		Collections credited to earnings— Continued.	
Executive office services.....	\$65,183.50	Business store sales.....	\$1,243,427.49
Cables and radiograms.....	43.02	Animal and motor transporta- tion.....	149,919.41
Sales of Canal Record.....	13.50	Motor car repair shops work.....	45,931.31
Clubs and playground services..	95,942.79	Building repairs and construction..	1,151,983.80
Accounting office services.....	182,428.96	Panama Canal press services.....	113,547.86
Lost metal checks.....	471.87	Gold quarters rentals.....	487,569.99
Paymaster's office services.....	18,602.42	Gold quarters, Balboa, refrigera- tion.....	1,378.55
Collector's office services.....	29,280.00	Silver quarters rentals.....	220,917.85
Safety deposit box rentals.....	643.50	Garage rentals.....	45,458.98
Office engineer services.....	1,073.30	Boathouse rentals.....	550.70
Sale of prints.....	8,618.58	Restaurant rentals.....	9,780.00
Meteorology and hydrography division services.....	22.78	Building and building site ren- tals.....	27,220.29
Survey section services.....	1,517.67	Building sites and rentals, Las Cascadas.....	2,775.92
Balboa storehouse services.....	716.12	Market rentals.....	2,625.74
Administration building store- house services.....	1.00	Sale of stove fuel.....	429.06
Cristobal storehouse services.....	242.41	Sale of gasoline.....	146,270.87
Chief quartermaster's office serv- ices.....	9,098.43	Sale of general supplies.....	15,359.97
District quartermaster, Balboa, services.....	17,160.56	Exchange of furniture.....	8,255.99
District quartermaster, Pedro Miguel, services.....	12,494.55	Exchange of mattresses.....	5,013.51
District quartermaster, Cristobal, services.....	5,213.01	Mattress factory sales.....	27,522.10
District quartermaster, Gatun, services.....	8,045.99	Janitor service.....	29,898.49
Port captain, Balboa, services....	2,682.93	Crank-case service.....	649.75
Port captain, Cristobal, services..	399.28	Hotel Tivoli.....	30,000.00
Admeasurement of vessels.....	1,160.00	Farm produce sales by agrono- mist.....	3,277.94
Inspection of vessels.....	4,080.90	Land rentals.....	28,100.94
Pilotage, Balboa.....	99,290.00	Marine salvage section.....	33,360.93
Pilotage, Cristobal.....	219,813.00	Sales of sand and gravel.....	39,004.85
Tug and launch service, Balboa..	139,472.50	Sales of nautical charts and pub- lications.....	2,156.85
Tug and launch service, Cristo- bal.....	178,185.10	Fortification division services....	277,499.84
Handling lines, Balboa.....	130,359.42	Collections credited to expenses:	
Handling lines, Cristobal.....	130,320.00	Injury compensation.....	182.27
Aids to navigation.....	5,982.71	Commissary coupons honored by the Panama Canal.....	479.00
Gatun locks, services.....	4.00	Electric work.....	9.90
Pedro Miguel locks, services.....	140.00	Telephone and telegraph work....	.50
Gatun Dam services.....	5,087.74	Water system.....	20.00
Dredging division work.....	367,154.16	Municipal engineering work.....	400.01
Electric current.....	365,791.81	Shops and dry docks.....	41.28
Electric work, general.....	157,467.68	Fuel-oil plants.....	133.55
Electric range and water heater rentals.....	5,593.48	Animal and motor transportation..	16.92
Telephone, telegraph, and signal work.....	188,339.72	Building repairs and construction..	1,516.33
Sale of water.....	247,447.14	Panama Canal press.....	704.21
Municipal engineering work.....	229,045.07	Gold quarters.....	719.86
Water rentals, Panama.....	270,355.12	Silver quarters.....	338.15
Water rentals, Colon.....	133,350.28	Rented buildings.....	10.70
Shop work.....	1,522,811.01	District quartermasters' supplies (sale of gas ranges).....	239.50
Dry dockage, Balboa.....	62,545.19	Farm Bureau.....	1,536.41
Dry dockage, Cristobal.....	19,393.42	Madden Dam services.....	570.00
Dockage and wharfage.....	97,374.53	Marine salvage sections.....	2,615.75
Handling fuel oil.....	448,968.27	Fortifications division.....	51.33
Fuel-oil sales.....	26,615.74	Stores adjustment reserve.....	118.63
Fuel oil tank and tank-site ren- tals.....	21,858.00	Claims against carriers and con- tractors.....	237.55

TABLE No. 29.—*Statement of collections made by collector repaid to appropriations and collections deposited to miscellaneous receipts during fiscal year ended June 30, 1931—Continued.*

MAINTENANCE AND OPERATION, PANAMA CANAL— continued		SANITATION, CANAL ZONE, PANAMA CANAL—contd.	
Collections credited to expenses— Continued.		Street cleaning and garbage collection,	
Surplus and obsolete property sold.....	\$11,799.07	Panama.....	\$66,846.35
Balboa store.....	3.75	Sanitation, Colon.....	1,553.14
District quartermaster, Cristobal.....	4,560.00	Street cleaning and garbage collection,	
Port captain, Balboa.....	2,499.88	Colon.....	42,644.73
Port captain, Cristobal.....	3,131.56	Sanitation, Canal Zone.....	20,282.15
Lighthouse subdivision.....	152.68	Refunds.....	5.16
Atlantic locks.....	49.35		
Pacific locks.....	8.15	Total, sanitation.....	837,761.30
Dredging division.....	26,701.85		
General accounts.....	485.53	CIVIL GOVERNMENT, PANAMA CANAL, AND CANAL ZONE	
Recruiting and repatriating employees.....	7.75	Customs.....	\$234.00
Damage to vessels in locks.....	37.85	Postal service.....	4,600.00
Total, maintenance and operation.....	9,747,170.41	School tuition.....	13,796.47
		Sale of school books.....	181.93
		Miscellaneous school credits.....	568.66
		Fire protection.....	72.75
		Police and prisons.....	65,477.99
		Refunds.....	53.93
		Total, civil government.....	84,985.73
SANITATION, CANAL ZONE, PANAMA CANAL		MISCELLANEOUS RECEIPTS	
Deduction certificates for medical services.....	\$28,051.94	Public works, Panama, amortization and interest.....	\$62,363.06
Chief health office.....	2,379.23	Public works, Colon, amortization and interest.....	46,559.92
Gorgas hospital fees.....	298,506.75	Tolls.....	24,644,550.39
Gorgas hospital mess.....	30,149.46	Postal receipts.....	257,061.52
Gorgas hospital burials.....	9,239.69	Licenses, motor vehicle.....	47,574.46
Gorgas hospital miscellaneous.....	10,331.56	Licenses, other.....	140.00
Colon hospital fees.....	69,604.32	Permits, personal.....	8,006.00
Colon hospital mess.....	5,555.17	Permits, corporate.....	2,934.31
Colon hospital miscellaneous.....	2,804.65	Fees, district court.....	2,443.24
Line dispensaries.....	27,592.62	Fees, magistrates' courts.....	467.50
Corozal farm produce.....	20,226.19	Fees, other.....	1,203.51
Corozal farm pasturage.....	32.80	Fines, district court.....	2,265.00
Corozal hospital fees.....	137,727.17	Fines, magistrates' courts.....	15,020.13
Corozal hospital miscellaneous.....	5,138.01	Interest on money-order funds.....	8,000.00
Palo Seco Colony.....	21,179.00		
Quarantine subsistence.....	10,043.53	Total, miscellaneous receipts.....	25,098,589.04
Quarantine miscellaneous.....	18,721.79		
Sanitation, Panama.....	9,145.89		
RECAPITULATION			
Maintenance and operation, Panama Canal.....			\$9,747,170.41
Sanitation, Canal Zone, Panama Canal.....			837,761.30
Civil government, Canal Zone, Panama Canal.....			84,985.73
Total repaid to appropriations.....			10,669,917.44
Miscellaneous receipts.....			25,098,589.04
Grand total.....			35,768,506.48

In addition to the foregoing the collector handled independent funds consisting of clubhouse funds, trust funds, postal savings, money-order funds, air-mail funds, and interest, as shown in Table No. 28, amounting to \$2,626,724.88. Collections for account of the Panama Railroad Co., not appearing in these tables, amounted to \$15,117,-106.35, making a total cash turnover of approximately \$53,500,000. The amount handled through the collector's security deposit accounts totaled \$30,341,324.18, as shown in Table No. 30.

TABLE No. 30.—Statement of collections in the collector's special deposit account

	Fiscal year, 1930			Fiscal year, 1931		
	United States	Isthmus	Total	United States	Isthmus	Total
On hand July 1.....	\$6,200.00	\$565,510.29	\$571,710.29		\$463,496.79	\$463,496.79
Deposits.....	30,090.42	33,918,668.94	33,948,759.36	\$64,560.00	30,276,704.18	30,341,324.18
Total.....	36,290.42	34,484,179.23	34,520,469.65	64,560.00	30,740,280.97	30,804,820.97
Disposition:						
Panama Canal bills applied.....	34,090.22	29,474,578.91	29,508,669.13	44,321.90	26,800,940.26	26,845,262.16
Payments to individuals and companies.....	1,735.13	4,460,439.77	4,462,174.90	149.22	3,490,097.45	3,490,246.67
Refunds.....	465.07	85,663.76	86,128.83	1,128.88	15,215.16	16,344.04
Total.....	36,290.42	34,020,682.44	34,056,972.86	45,600.00	30,306,252.87	30,351,852.87
Balance on hand June 30.....		463,496.79	463,496.79	18,960.00	434,008.10	452,968.10

TABLE No. 31.—Postal Service—statement showing the monthly money order business of the Canal Zone Postal Service during the fiscal year ended June 30, 1931

Month	Money orders issued including deposit money orders		Interest paid on deposit money orders	Money orders paid by Canal Zone post offices			Canal Zone money orders paid by—		
	Number	Amount		United States	Costa Rica	Canal Zone ¹	Costa Rica	United States	
1930	July.....	9,795	\$208,475.59	\$1,170.33	\$18,477.21	\$74.15	\$73,712.00	\$1,990.45	\$134,110.99
	August.....	9,676	206,089.50	838.54	22,304.62	94.00	64,646.98	—	112,008.50
	September.....	9,708	205,361.58	1,273.29	18,180.06	50.10	68,655.02	2,209.19	161,576.47
	October.....	10,212	219,733.89	1,067.94	17,425.34	34.92	60,598.84	—	171,022.27
	November.....	10,810	217,955.92	935.78	17,549.56	16.00	58,864.23	—	161,690.53
	December.....	14,645	269,148.73	586.55	27,023.39	134.68	58,612.40	2,736.95	132,943.11
1931	January.....	11,041	245,247.24	1,129.27	16,431.55	193.80	58,997.40	—	184,127.91
	February.....	13,495	312,719.23	1,015.67	16,891.67	25.25	59,868.30	—	208,025.81
	March.....	15,163	361,720.66	502.84	18,175.52	39.57	56,017.00	1,318.75	173,847.23
	April.....	11,848	308,750.62	831.92	20,937.32	68.70	63,952.62	—	182,385.25

TABLE No. 32.—*Postal service—Statement of postal revenues, fiscal year ended June 30, 1931*

1 Including deposit money orders.

Month	Receipts					Total revenue	Interest on money-order funds
	Miscellaneous	Money-order fees	Stamp sales	Newspaper postage	Box rent		
1930							
July.....	\$100.00	\$952.31	\$15,324.46	\$449.18	\$1,711.60	\$18,537.55	\$2,572.80
August.....	100.00	962.59	14,821.38	484.04	246.40	16,614.41	1,023.85
September.....	100.00	936.97	14,204.52	464.81	1,910.00	17,616.30	1,052.78
October.....	100.00	991.60	17,618.69	571.10	1,737.20	21,018.59	4,832.29
November.....	100.00	1,051.60	15,970.57	445.86	109.20	17,677.23	985.61
December.....	100.00	1,377.60	25,499.09	466.81	1,845.25	29,288.75	992.04
1931							
January.....	100.00	1,080.12	17,730.99	302.46	2,376.00	21,589.57	2,541.36
February.....	100.00	1,389.82	24,008.98	242.16	108.65	25,849.61	1,070.10
March.....	100.00	1,558.20	22,730.13	233.81	1,909.10	26,531.24	1,027.21
April.....	100.00	1,111.46	18,725.20	224.97	2,077.30	22,238.93	5,098.72
May.....	213.97	1,122.88	19,148.33	217.55	1,122.70	20,826.73	1,440.28
June.....	100.00	1,080.36	15,791.34	208.55	1,694.00	18,874.55	1,654.42
Total, 1931.....	1,313.97	13,615.51	221,573.68	4,311.90	15,847.40	256,662.46	24,292.74
Total, 1907-1930.....	70,088.86	346,369.34	2,288,474.71	37,213.50	161,021.60	2,903,168.01	340,589.12
Total, 1907-1931.....	71,402.83	359,984.85	2,510,048.39	41,525.40	176,869.00	3,159,830.47	364,881.86

May.....	11,628	284,411.47	889.86	22,714.93	46.20	98,129.14	295,042.82
June.....	11,453	263,458.21	1,344.39	21,810.97	76.23	103,830.46	135,128.79
Total.....	139,474	3,102,481.64	11,586.38	237,942.14	853.65	825,884.39	2,051,909.68

TABLE No. 33.—*Number of injuries and deaths for the Panama Canal and Panama Railroad Co., and expenditures for account of the United States Employees' Compensation Commission*

PANAMA CANAL DEPARTMENTS AND DIVISIONS

	Marine	Locks	Dredging	Mechanical	Municipal engineering	Electrical	Constructing quartermaster	Health department	Civil government	Fortifications	Panama Canal, all other divisions	Grand total Panama Canal divisions
Classification of payments made during the fiscal year ending June 30, 1931.												
Lump-sum payments.....	\$585.62	\$4,361.54	\$6,191.84	\$6,962.90	\$3,664.49	\$2,662.70	\$851.14	\$259.72	\$1,047.32	\$626.68	\$1,122.34	\$851.14 31,401.57
Monthly payments.....												
Total payments.....	585.62	4,361.54	6,191.84	6,962.90	3,664.49	2,662.70	4,767.56	259.72	1,047.32	626.68	1,122.34	32,252.71
Classification of payments made during the fiscal year ending June 30, 1930:												
Lump-sum payments.....	1,107.28		4,235.15		422.54							5,764.97
Monthly payments.....	709.64	3,036.91	7,746.43	8,378.49	4,812.74	2,611.29	4,276.23	439.76	1,030.88	724.27	1,219.29	34,985.93
Total payments.....	1,816.92	3,036.91	11,981.58	8,378.49	5,235.28	2,611.29	4,276.23	439.76	1,030.88	724.27	1,219.29	40,750.90
Classification of payments made during the fiscal year ending June 30, 1929:												
Lump-sum payments.....	1,339.36	2,574.32	6,619.16	8,217.63	4,701.63	2,422.19	956.25	585.81	825.95	1,089.97	1,427.18	4,287.05 33,942.37
Monthly payments.....												
Total payments.....	1,339.36	2,574.32	6,619.16	11,548.43	4,701.63	2,422.19	5,095.42	585.81	825.95	1,089.97	1,427.18	38,220.42
Injuries incurred during—												
Fiscal year 1931.....	38	120	99	129	146	22	82	33	5	23	130	817
Fiscal year 1930.....	36	50	105	163	205	21	116	53	8	45	72	874
Fiscal year 1929.....	30	46	73	149	168	10	70	45	4	62	60	717
Deaths occurred during—												
Fiscal year 1931.....	1	4	3	1	2		1				1	6
Fiscal year 1930.....		1	3	1	1							7
Fiscal year 1929.....		4	2	1								9
Time lost account injuries during fiscal year 1931:												
4 to 7 days.....	15	39	35	47	53	6	33	11	2	6	48	295
8 to 14 days.....	11	43	30	27	45	10	27	12	1	8	44	258
15 to 28 days.....	6	25	21	36	37	2	12	7		6	17	169
Over 28 days.....	6	11	10	18	9	4	8	3	2	3	10	84
Permanent disability.....		2		1			2					5
Total.....	38	120	96	129	144	22	82	33	5	23	119	811

PANAMA RAILROAD CO. DIVISIONS AND GRAND TOTAL PANAMA CANAL AND PANAMA RAILROAD

	Harbor terminals	Commissary	Coaling	All other Panama R. R. departments and divisions	Total Panama R. R. divisions	Grand total Panama Canal and Panama R. R. divisions	Amount chargeable current fiscal year	Amount chargeable previous fiscal years 1916-1930	Total payments
Classification of payments made during the fiscal year ending June 30, 1931:									
Lump sums.....	\$1,751.42				\$1,751.42	\$2,602.56	\$1,494.18	\$1,108.38	\$2,602.56
Monthly payments.....	4,128.64	\$1,686.24	\$755.60	\$4,415.22	10,985.70	42,387.27	12,215.21	30,172.06	42,387.27
Total payments.....	5,880.06	1,686.24	755.60	4,415.22	12,737.12	44,989.83	13,709.39	31,280.44	44,989.83
Classification of payments made during the fiscal year ending June 30, 1930:									
Lump sums.....	4,199.29	1,439.77	752.70	4,399.30	10,791.06	5,764.97		5,764.97	
Monthly payments.....	4,199.29	1,439.77	752.70	4,399.30	10,791.06	45,776.99		45,776.99	
Total payments.....					10,791.06	51,541.96		51,541.96	51,541.96
Classification of payments made during the fiscal year ending June 30, 1929:									
Lump sums.....	6,256.78	856.49			856.49	5,143.54		5,143.54	
Monthly payments.....	6,256.78	1,618.53	1,090.47	4,409.17	13,374.95	47,317.32		47,317.32	
Total payments.....		2,475.02	1,090.47	4,409.17	14,231.44	52,460.86		52,460.86	52,460.86
Injuries incurred during—									
Fiscal year 1931.....	173	76	19	66	334	1,143	1,143		
Fiscal year 1930.....	170	56	28	69	323	1,197	1,197		
Fiscal year 1929.....	231	58	30	43	359	1,076	1,076		
Deaths occurred during—									
Fiscal year 1931.....			1	1	2	8	18		
Fiscal year 1930.....						7	7		
Fiscal year 1929.....	3	2	1		6	15	15		
							Grand totals previous years		
							Year 1931		
							1930		
							1929		
Time lost on account of injuries during fiscal year 1931:									
3 days and less.....							15,274	5,468	5,164
4 to 7 days.....	56	31	8	24	119	414	414	426	391
8 to 14 days.....	63	23	3	27	116	374	374	369	324
15 to 28 days.....	32	10	4	10	56	225	225	267	193
Over 28 days.....	21	11	3	3	38	122	122	127	122
Permanent disability.....	1	1		1	3	8	8		31
Total.....	173	76	18	65	332	1,143	6,417	6,665	6,225

¹ In addition to the above 1,143 cases of injury there were 5,274 (not arranged by divisions) which lost 3 days or less and for which no compensation was paid; therefore, the total number of injury cases for the fiscal year ending June 30, 1931, is 6,417 injury and 8 death cases, making grand total number of cases handled during the year 6,425.

TABLE NO. 59.—*Statement showing the origin and destination of cargo passing through the canal, Atlantic to Pacific*

Origin of cargo	Total cargo tonnage	Tonnage destined for—			
		West coast of North America	West coast of South America	Asia	Australasia
East coast of United States:					
Fiscal year 1927.....	5,783,266	2,953,836	391,302	1,625,186	809,942
Fiscal year 1928.....	5,325,883	2,649,166	356,929	1,682,085	637,703
Fiscal year 1929.....	6,539,037	3,381,665	404,928	2,111,175	641,269
Fiscal year 1930.....	6,203,780	3,330,329	378,101	2,072,511	422,839
Fiscal year 1931.....	4,395,413	2,579,967	252,363	1,360,772	202,311
East coast of North America (other than United States):					
Fiscal year 1927.....	729,975	229,373	84,982	204,070	211,550
Fiscal year 1928.....	300,649	204,076	77,951	14,384	94,238
Fiscal year 1929.....	800,098	371,970	157,680	60,442	210,006
Fiscal year 1930.....	644,219	238,238	153,717	19,296	232,968
Fiscal year 1931.....	511,934	246,267	113,372	26,347	125,948
Europe:					
Fiscal year 1927.....	1,896,140	784,279	605,361	6,902	499,598
Fiscal year 1928.....	2,126,987	815,461	761,567	5,077	544,882
Fiscal year 1929.....	2,385,875	947,002	845,760	9,136	583,977
Fiscal year 1930.....	2,451,778	955,623	881,666	10,224	604,265
Fiscal year 1931.....	1,591,066	638,230	503,566	7,800	441,470
East coast of South America and miscellaneous:					
Fiscal year 1927.....	173,946	152,357	6,009	15,580	-----
Fiscal year 1928.....	466,615	427,820	9,939	7,680	21,176
Fiscal year 1929.....	157,510	99,904	24,415	11,871	21,320
Fiscal year 1930.....	175,948	119,656	13,087	14,988	28,217
Fiscal year 1931.....	182,016	138,739	5,164	30,651	7,462
Grand total:					
Fiscal year 1927.....	8,583,327	4,119,845	1,087,654	1,854,738	1,521,090
Fiscal year 1928.....	8,310,134	4,096,523	1,206,386	1,709,226	1,297,999
Fiscal year 1929.....	9,882,520	4,800,541	1,432,783	2,192,624	1,456,572
Fiscal year 1930.....	9,475,725	4,643,846	1,426,571	2,117,019	1,288,289
Fiscal year 1931.....	6,680,429	3,603,203	874,465	1,425,570	777,191

TABLE NO. 60.—*Statement showing the origin and destination of cargo passing through the canal, Pacific to Atlantic*

Origin of cargo	Total cargo tonnage	Tonnage destined for—			
		East coast of United States	Other North America	Europe	Africa, South America, and miscellaneous
West coast of North America:					
Fiscal year 1927.....	13,722,868	8,544,489	1,172,178	3,815,829	190,372
Fiscal year 1928.....	14,701,573	8,153,607	1,236,638	5,163,573	147,755
Fiscal year 1929.....	13,262,071	7,442,938	524,373	5,218,015	76,745
Fiscal year 1930.....	13,082,391	7,781,863	464,680	4,740,895	94,953
Fiscal year 1931.....	12,108,625	6,814,512	514,619	4,682,985	96,509
West coast of South America:					
Fiscal year 1927.....	4,420,091	2,498,445	455,466	1,316,050	150,130
Fiscal year 1928.....	5,440,090	2,822,886	487,300	2,000,112	129,702
Fiscal year 1929.....	6,008,169	2,994,043	541,715	2,382,935	89,476
Fiscal year 1930.....	5,671,970	3,144,475	466,957	1,934,744	125,794
Fiscal year 1931.....	4,383,104	2,105,298	462,841	1,804,191	10,774
Australasia:					
Fiscal year 1927.....	571,939	80,269	15,747	475,923	-----
Fiscal year 1928.....	683,662	106,678	24,421	552,563	-----
Fiscal year 1929.....	756,205	164,746	18,247	573,212	-----
Fiscal year 1930.....	868,712	238,803	34,979	594,930	-----
Fiscal year 1931.....	862,825	166,648	24,331	671,843	3
Asia:					
Fiscal year 1927.....	449,990	370,109	58,843	21,038	-----
Fiscal year 1928.....	495,340	429,511	30,267	35,562	-----
Fiscal year 1929.....	754,041	638,618	74,880	40,543	-----
Fiscal year 1930.....	931,434	818,184	69,535	42,105	1,610
Fiscal year 1931.....	1,047,817	862,053	86,393	98,440	931
Grand total:					
Fiscal year 1927.....	19,164,888	11,493,312	1,702,234	5,628,840	340,502
Fiscal year 1928.....	21,320,575	11,512,682	1,778,626	7,751,810	277,457
Fiscal year 1929.....	20,780,486	11,240,345	1,159,215	8,214,705	166,221
Fiscal year 1930.....	20,554,507	11,933,325	1,036,151	7,312,674	222,357
Fiscal year 1931.....	18,402,371	9,948,511	1,088,184	7,257,459	108,217

TABLE NO. 61.—Statement showing, by nationality, the number of transits of vessels, aggregate Panama Canal net tonnage, tolls assessed, and tons of cargo carried through the Panama Canal from the opening of the Canal, August 15, 1914, to June 30, 1924, and by fiscal years ending June 30 from fiscal year 1925 to 1931, inclusive

Nationality and fiscal year	Number of ships	Panama Canal net tonnage	Tolls	Tons of cargo
Argentine:				
1915 to 1924.....	3	2,335	\$3,501.00	-----
1925.....	2	4,727	16,887.44	-----
1927.....	1	(1)	1,200.00	-----
1929.....	1	(1)	1,274.50	-----
1930.....	2	3,816	4,015.52	-----
Total.....	9	10,878	26,878.46	-----
Belgian:				
1915 to 1924.....	7	22,147	26,127.50	37,522
1925.....	4	12,825	13,907.50	23,259
1926.....	19	81,774	78,052.62	87,829
1927.....	16	79,214	75,245.31	82,558
1928.....	13	61,293	57,407.25	67,411
1929.....	17	89,695	83,757.04	101,419
1930.....	23	119,499	122,440.19	155,484
1931.....	24	124,377	116,452.51	156,411
Total.....	123	590,824	573,389.92	711,893
Brazilian: 1915 to 1924.....	4	23,730	23,606.63	15,616
British:				
1915 to 1924.....	7,902	31,424,119	31,109,719.88	32,537,083
1925.....	1,211	5,949,391	5,734,039.19	5,917,058
1926.....	1,423	7,039,542	6,569,712.05	6,750,843
1927.....	1,351	6,942,555	6,452,527.30	6,436,785
1928.....	1,842	2,976,960	8,073,815.68	8,075,022
1929.....	1,783	8,994,526	8,025,045.81	8,331,221
1930.....	1,536	8,006,962	7,197,979.33	7,572,969
1931.....	1,390	7,518,171	6,580,987.70	5,971,281
Total.....	18,438	84,852,226	79,743,826.94	81,592,262
Chilean:				
1915 to 1924.....	660	1,859,501	1,601,186.55	999,971
1925.....	29	129,183	121,699.25	96,369
1926.....	26	121,901	113,603.75	82,695
1927.....	27	114,427	106,899.60	86,960
1928.....	32	124,959	118,862.95	81,678
1929.....	31	130,599	136,663.49	98,584
1930.....	46	164,152	153,998.86	105,511
1931.....	42	170,928	166,782.50	99,234
Total.....	893	2,815,650	2,519,696.95	1,651,002
Chinese: 1915 to 1924.....	12	42,900	47,029.70	54,938
Colombian:				
1915 to 1924.....	42	11,958	13,876.21	12,978
1925.....	23	1,752	1,758.77	1,563
1926.....	46	4,897	5,195.40	5,378
1927.....	52	21,500	22,592.25	20,917
1928.....	99	39,162	41,194.42	33,909
1929.....	101	39,032	41,652.43	38,262
1930.....	74	13,026	15,371.33	12,543
1931.....	104	15,526	17,840.61	17,847
Total.....	541	146,853	159,481.42	143,397
Costa Rican:				
1915 to 1924.....	73	7,353	8,420.23	8,414
1927.....	2	138	103.50	-----
1928.....	2	138	103.50	-----
1929.....	1	39	29.25	-----
1930.....	2	662	646.95	600
Total.....	80	8,330	9,303.43	9,014
Cuban:				
1915 to 1924.....	7	9,994	10,570.00	8,570
1929.....	1	194	242.50	20
Total.....	8	10,188	10,812.50	8,590

¹ War vessels, tonnage displacement.

TABLE No. 61.—Statement showing, by nationality, the number of transits of vessels, aggregate Panama Canal net tonnage, tolls assessed, and tons of cargo carried through the Panama Canal from the opening of the Canal, August 15, 1914, to June 30, 1924, and by fiscal years ending June 30 from fiscal year 1925 to 1931, inclusive—Contd.

Nationality and fiscal year	Number of ships	Panama Canal net tonnage	Tolls	Tons of cargo
Danish:				
1915 to 1924.....	516	1,793,098	\$1,734,107.54	2,461,981
1925.....	42	160,299	152,641.74	201,577
1926.....	63	234,753	223,595.27	295,530
1927.....	46	198,432	187,640.36	261,543
1928.....	69	285,396	271,851.95	380,240
1929.....	101	416,985	379,383.44	518,452
1930.....	91	381,766	352,788.65	505,914
1931.....	120	611,380	519,535.67	606,100
Total.....	1,048	4,082,109	3,821,544.62	5,231,337
Danzig:				
1915 to 1924.....	11	88,276	72,498.00	54,764
1925.....	10	80,164	61,920.53	54,607
1926.....	15	105,460	89,852.25	95,604
1927.....	29	192,947	166,959.26	159,362
1928.....	29	190,947	163,504.90	154,597
1929.....	30	187,403	167,731.28	183,844
1930.....	36	221,382	195,633.92	192,734
1931.....	27	184,928	165,459.25	185,982
Total.....	187	1,251,507	1,083,559.39	1,081,494
Dutch:				
1915 to 1924.....	519	2,364,638	2,206,435.41	2,452,313
1925.....	102	531,251	484,614.29	619,017
1926.....	93	530,652	489,405.80	552,741
1927.....	105	575,065	542,023.19	571,700
1928.....	137	644,390	561,044.93	637,178
1929.....	149	690,608	595,905.62	695,956
1930.....	141	671,250	571,860.62	618,718
1931.....	125	578,680	473,269.39	477,769
Total.....	1,371	6,586,534	5,924,559.25	6,625,392
Ecuadorian:				
1915 to 1924.....	2	102	109.50	72
1926.....	3	453	477.90	340
1927.....	6	1,210	1,322.46	1,638
1928.....	1	307	368.40	500
Total.....	12	2,072	2,278.26	2,550
Finnish:				
1915 to 1924.....	5	9,079	10,894.80	14,601
1925.....	3	8,145	8,974.00	12,892
1926.....	2	3,632	4,358.40	6,600
1927.....	2	3,722	3,644.55	3,100
1928.....	3	8,128	8,922.60	9,544
1929.....	7	16,314	16,860.00	25,000
1930.....	2	3,810	4,572.00	5,450
Total.....	24	52,830	58,226.35	77,187
French:				
1915 to 1924.....	463	1,555,211	1,688,873.41	1,539,099
1925.....	105	489,806	491,042.27	481,526
1926.....	90	421,752	414,556.96	398,393
1927.....	116	535,719	518,419.78	530,026
1928.....	127	580,769	576,627.46	600,421
1929.....	115	534,505	532,777.65	530,763
1930.....	124	627,760	583,153.10	576,753
1931.....	110	609,915	523,263.93	508,011
Total.....	1,250	5,355,437	5,328,714.56	5,164,992
German:				
1915 to 1924.....	313	1,239,287	1,149,430.58	1,322,201
1925.....	163	723,067	660,896.34	830,512
1926.....	163	726,340	658,858.12	885,007
1927.....	212	779,812	707,510.22	973,741
1928.....	316	995,629	892,511.39	1,185,421
1929.....	402	1,405,385	1,222,181.38	1,482,279
1930.....	377	1,433,074	1,236,213.16	1,388,022
1931.....	369	1,412,256	1,204,084.62	1,261,763
Total.....	2,315	8,714,850	7,731,085.81	9,328,946

TABLE NO. 61.—Statement showing by nationality, the number of transits of vessels, aggregate Panama Canal net tonnage, tolls assessed, and tons of cargo carried through the Panama Canal from the opening of the Canal, August 15, 1914, to June 30, 1924, and by fiscal years ending June 30 from fiscal year 1925 to 1931, inclusive—Continued

Nationality and fiscal year	Number of ships	Panama Canal net tonnage	Tolls	Tons of cargo
Greek:				
1915 to 1924.....	17	60,757	\$55,621.67	63,093
1925.....	3	11,545	11,810.00	18,823
1926.....	8	32,076	28,996.52	35,432
1927.....	1	4,047	4,010.00	6,124
1928.....	12	46,040	40,233.42	66,554
1929.....	67	261,540	218,427.77	299,104
1930.....	22	89,221	77,863.75	160,219
1931.....	8	30,965	26,342.87	45,273
Total.....	138	536,191	463,306.60	694,622
Honduran:				
1915 to 1924.....	6	606	561.00	321
1926.....	20	28,443	25,541.40	6,126
1927.....	1	425	306.00	-----
1928.....	1	991	1,189.20	552
Total.....	28	30,465	27,597.60	6,999
Irish: 1925.....	8	29,176	25,833.36	24,286
Italian:				
1915 to 1924.....	152	588,765	597,250.99	371,087
1925.....	57	241,054	257,881.25	180,062
1926.....	90	379,990	405,031.30	322,236
1927.....	74	344,491	363,168.32	308,050
1928.....	118	580,721	567,807.85	498,807
1929.....	83	492,472	446,623.34	334,483
1930.....	66	429,091	385,290.89	264,223
1931.....	67	468,239	404,674.43	236,570
Total.....	707	3,524,823	3,427,728.37	2,515,518
Japanese:				
1915 to 1924.....	1,020	4,547,734	4,850,555.81	5,925,679
1925.....	172	823,869	853,199.19	946,016
1926.....	131	649,028	671,071.35	667,982
1927.....	165	818,310	862,699.61	1,036,786
1928.....	188	909,232	949,424.69	1,041,166
1929.....	155	775,005	810,215.74	980,041
1930.....	163	803,182	851,013.31	1,009,735
1931.....	193	1,019,832	1,052,413.33	1,104,512
Total.....	2,187	10,346,192	10,900,593.03	12,712,817
Mexican:				
1915 to 1924.....	28	34,523	35,562.07	26,735
1925.....	2	4,291	4,056.25	2,400
1926.....	1	2,025	2,111.25	1,064
1927.....	1	2,159	1,961.25	2,145
1929.....	1	(1)	613.50	-----
1930.....	1	2,159	1,961.25	1,140
Total.....	34	45,157	44,265.57	33,484
Nicaraguan:				
1915 to 1924.....	3	1,644	1,205.76	6
1925.....	1	425	306.00	-----
1930.....	1	140	113.25	-----
Total.....	5	2,209	1,625.01	6
Norwegian:				
1915 to 1924.....	1,297	4,642,206	4,348,487.30	5,355,844
1925.....	192	672,663	619,403.58	842,708
1926.....	306	987,040	875,812.99	1,051,276
1927.....	265	907,675	808,621.74	1,052,453
1928.....	313	1,181,189	1,052,127.36	1,268,124
1929.....	340	1,280,184	1,122,895.34	1,505,366
1930.....	371	1,660,101	1,410,130.81	1,808,278
1931.....	363	1,748,728	1,403,922.86	1,720,383
Total.....	3,447	13,079,786	11,641,401.98	14,004,432

TABLE NO. 61.—Statement showing, by nationality, the number of transits of vessels, aggregate Panama Canal net tonnage, tolls assessed, and tons of cargo carried through the Panama Canal from the opening of the Canal, August 15, 1914, to June 30, 1924, and by fiscal years ending June 30, from fiscal year 1925 to 1931, inclusive—Continued

Nationality and fiscal year	Number of ships	Panama Canal net tonnage	Tolls	Tons of cargo
Panamanian:				
1915 to 1924.....	83	108,635	\$103,283.75	79,341
1925.....	36	68,656	51,844.12	53,627
1926.....	53	84,295	64,187.40	63,922
1927.....	105	85,374	66,844.25	87,776
1928.....	138	82,650	64,370.53	65,559
1929.....	47	113,097	91,133.63	97,644
1930.....	60	87,826	68,027.22	73,821
1931.....	36	82,841	60,204.86	55,422
Total.....	558	713,374	569,895.76	577,112
Peruvian:				
1915 to 1924.....	612	1,595,328	1,240,525.44	997,654
1925.....	73	188,784	126,985.45	101,005
1926.....	64	149,162	111,618.67	94,778
1927.....	63	143,157	123,125.70	107,997
1928.....	53	140,323	107,576.65	96,175
1929.....	48	109,100	77,183.43	69,573
1930.....	2	8,959	9,724.50	13,107
1931.....	2	7,088	8,565.60	7,328
Total.....	917	2,341,901	1,805,305.44	1,487,617
Portuguese:				
1915 to 1924.....	2	9,002	10,802.40	10,775
1926.....	1	2,360	2,645.00	4,500
Total.....	3	11,362	13,447.40	15,275
Russian: 1915 to 1924.....	21	57,192	56,982.27	63,893
Spanish:				
1915 to 1924.....	189	549,747	530,785.18	484,942
1925.....	43	159,579	147,985.73	72,011
1926.....	31	121,461	117,786.81	49,956
1927.....	30	110,544	107,904.65	47,576
1928.....	46	157,465	151,375.32	104,606
1929.....	32	117,528	116,720.34	95,405
1930.....	2	4,209	6,264.00	8,250
1931.....	9	22,650	22,053.99	27,030
Total.....	382	1,243,183	1,200,876.02	889,776
Swedish:				
1915 to 1924.....	250	944,724	814,681.44	1,218,018
1925.....	49	225,593	186,404.82	282,447
1926.....	84	369,272	311,174.14	636,266
1927.....	106	394,907	329,804.98	652,173
1928.....	111	480,006	396,908.28	705,154
1929.....	144	618,558	520,155.43	845,664
1930.....	125	571,535	473,278.45	832,273
1931.....	111	528,282	424,924.05	721,945
Total.....	980	4,132,877	3,457,331.59	5,893,940
United States:				
1915 to 1924.....	10,802	47,193,801	45,421,836.69	51,739,924
1925.....	2,326	12,271,387	11,302,031.19	13,080,200
1926.....	2,432	12,565,255	11,539,809.38	13,710,956
1927.....	2,685	13,914,645	12,720,447.95	15,242,156
1928.....	2,753	13,752,957	12,645,880.20	14,248,735
1929.....	2,700	13,325,753	12,299,584.70	14,075,731
1930.....	2,885	14,534,495	13,220,662.70	14,499,233
1931.....	2,417	12,601,828	11,425,999.31	11,805,132
Total.....	29,000	140,160,121	130,576,252.12	148,402,067
Uruguayan: 1915 to 1924.....	2	410	2,136.00	-----

TABLE NO. 61.—Statement showing by nationality, the number of transits of vessels, aggregate Panama Canal net tonnage, tolls assessed, and tons of cargo carried through the Panama Canal from the opening of the Canal, August 15, 1914, to June 30, 1924, and by fiscal years ending June 30, from fiscal year 1925 to 1931, inclusive—Continued

Nationality and fiscal year	Number of ships	Panama Canal net tonnage	Tolls	Tons of cargo
Yugoslav:				
1915 to 1924.....	9	31, 595	\$28, 153. 75	53, 556
1925.....	17	67, 519	64, 401. 25	115, 971
1926.....	33	133, 028	127, 601. 25	231, 994
1927.....	14	57, 340	53, 847. 88	76, 649
1928.....	53	218, 982	201, 390. 84	309, 356
1929.....	57	239, 272	220, 319. 30	354, 195
1930.....	33	142, 537	133, 886. 25	225, 255
1931.....	12	55, 532	48, 679. 09	74, 807
Total.....	228	945, 805	878, 279. 61	1, 441, 783
Total traffic:				
1915 to 1924.....	25, 032	100, 820, 397	97, 802, 818. 46	107, 910, 991
1925.....	4, 673	22, 855, 151	21, 400, 523. 51	23, 958, 836
1926.....	5, 197	24, 774, 591	22, 931, 055. 98	26, 037, 448
1927.....	5, 475	26, 227, 815	24, 228, 830. 11	27, 748, 215
1928.....	6, 456	29, 458, 634	26, 944, 499. 77	29, 630, 709
1929.....	6, 413	29, 837, 794	27, 127, 376. 91	30, 663, 006
1930.....	6, 185	29, 980, 614	27, 076, 890. 01	30, 030, 232
1931.....	5, 529	27, 792, 146	24, 645, 456. 57	25, 082, 800
Total.....	64, 960	291, 747, 142	272, 157, 451. 32	301, 062, 237

PLATE 13

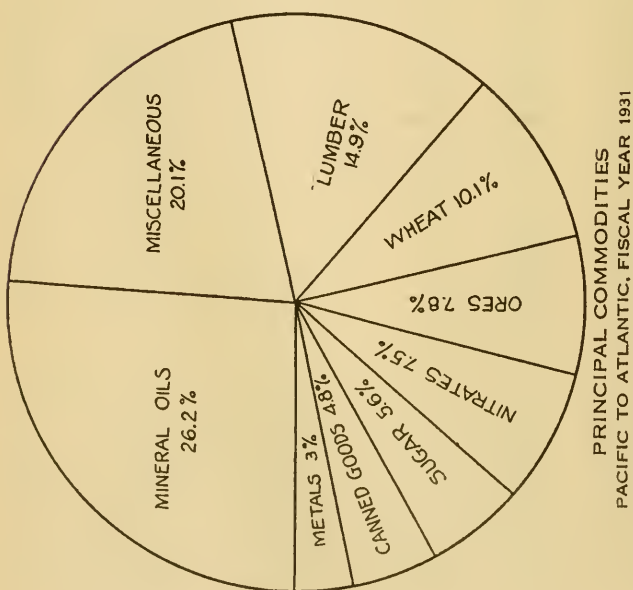
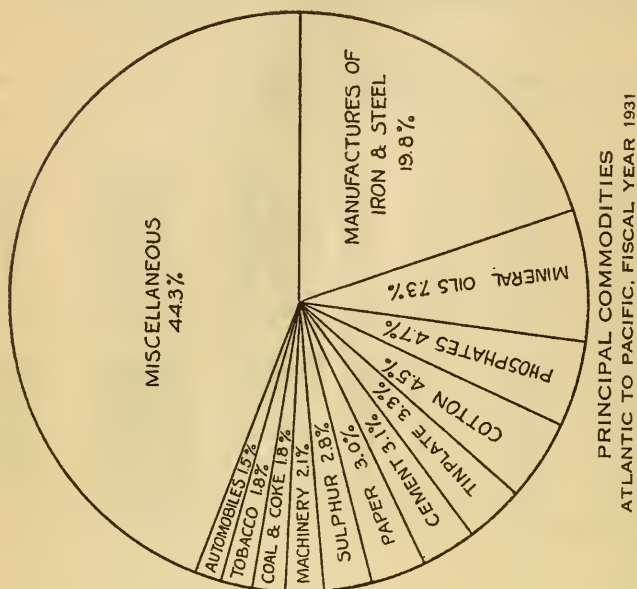


PLATE 14

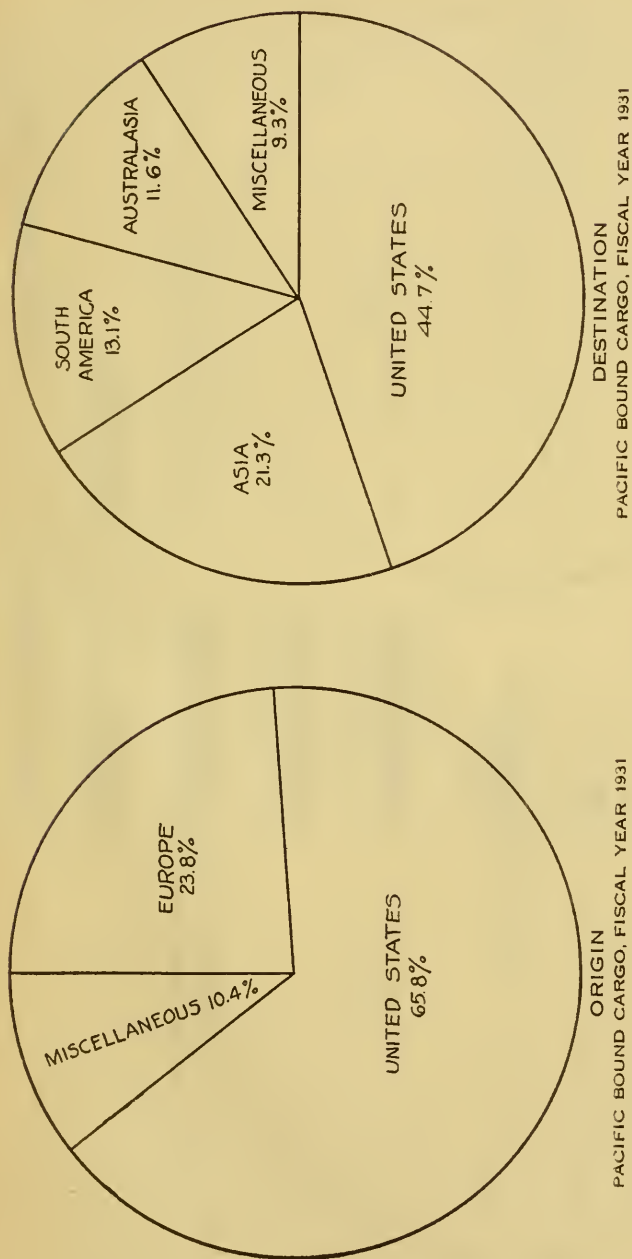
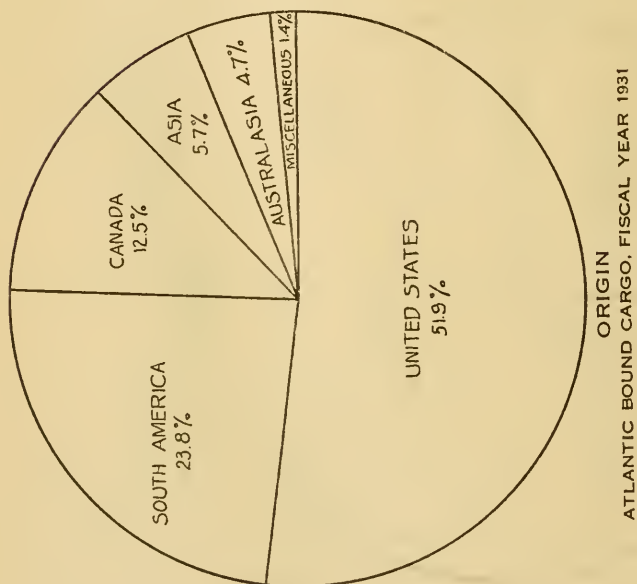
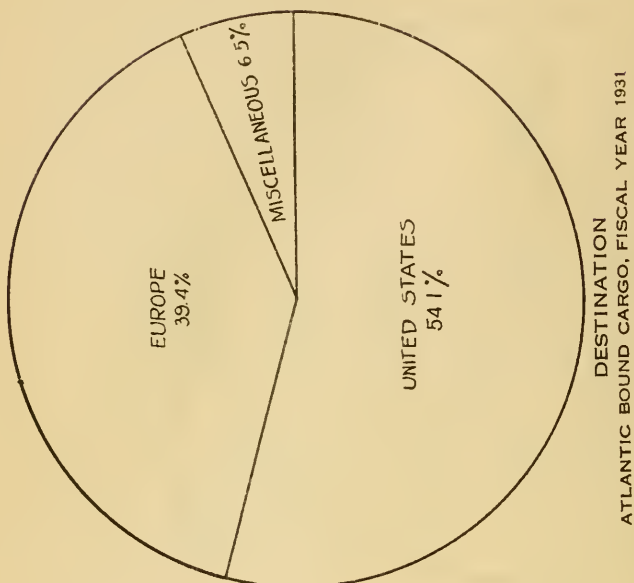
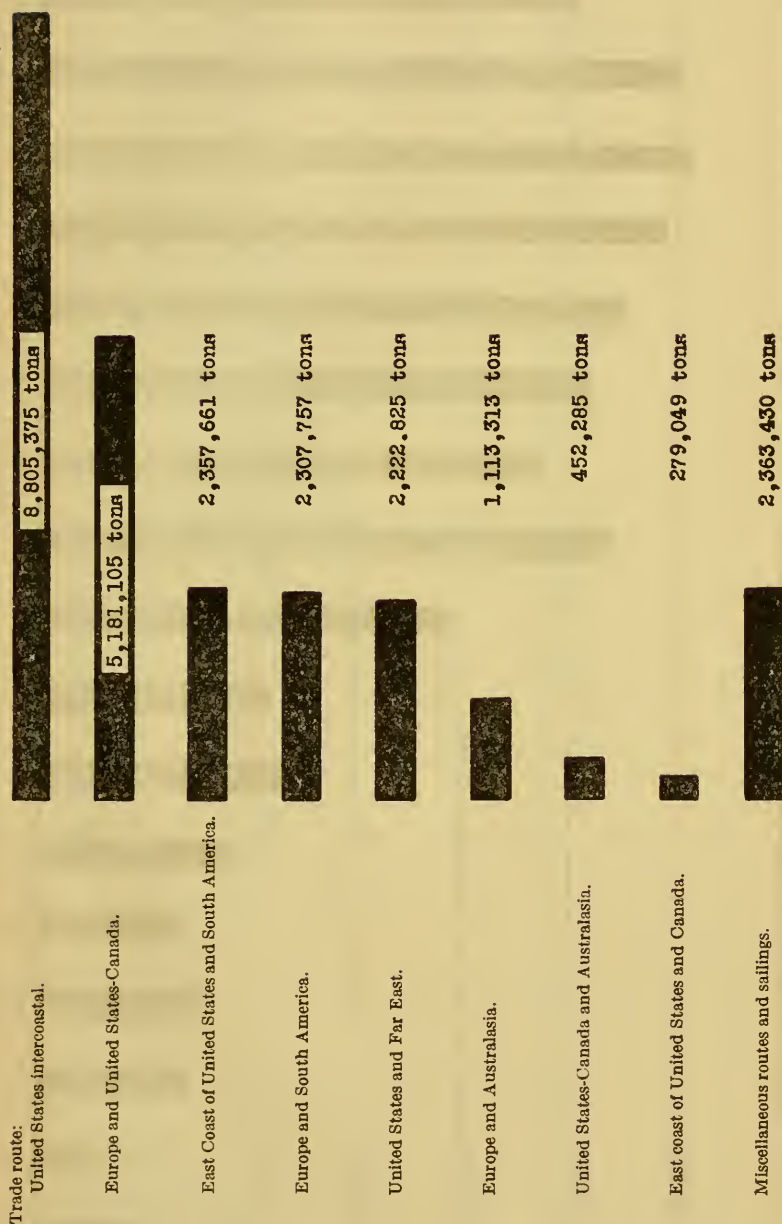


PLATE 15

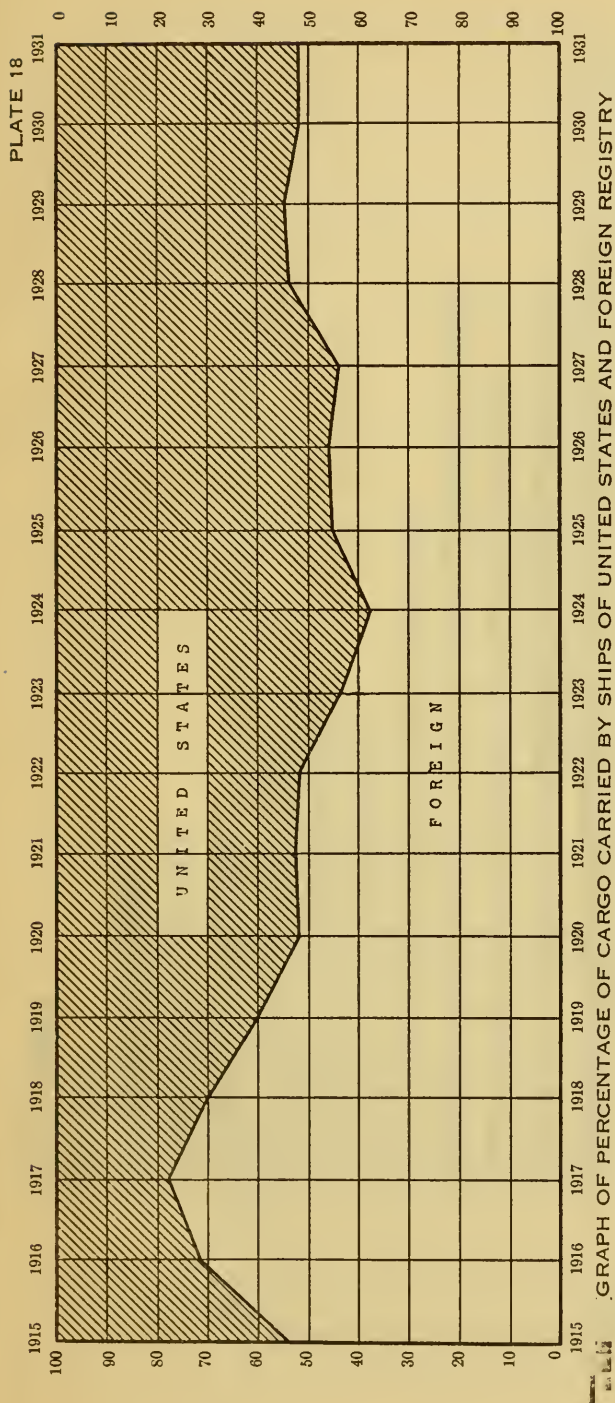


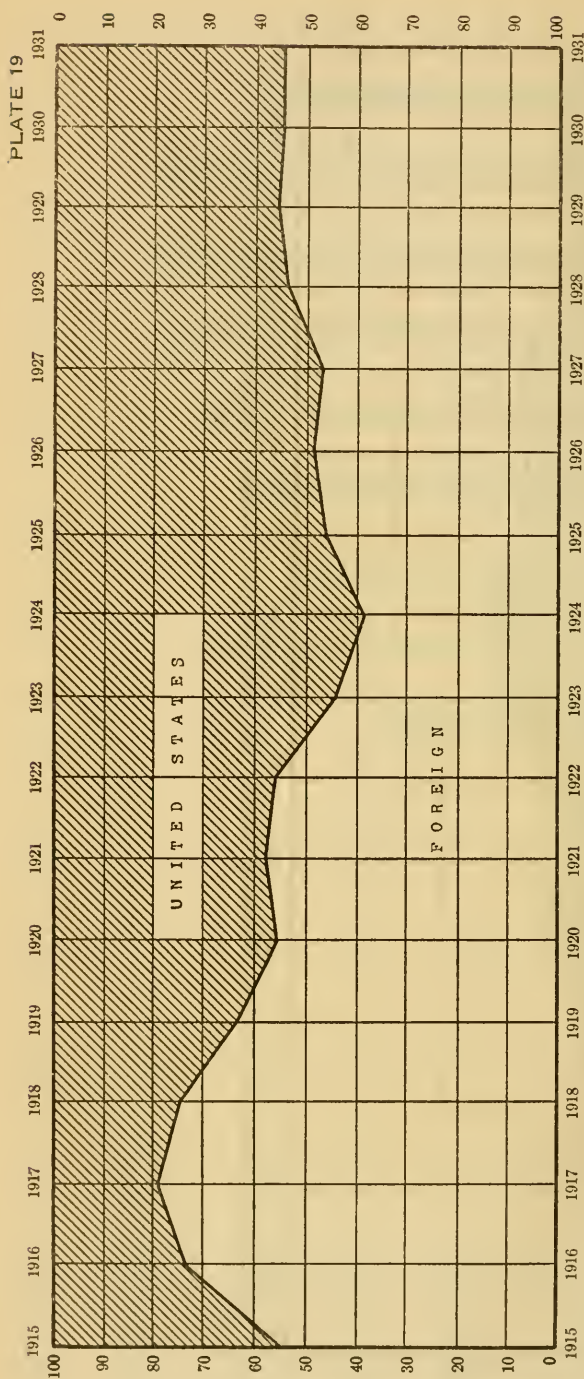


GRAPH OF TONNAGE OF CARGO OVER PRINCIPAL TRADE ROUTES, FISCAL YEAR 1931

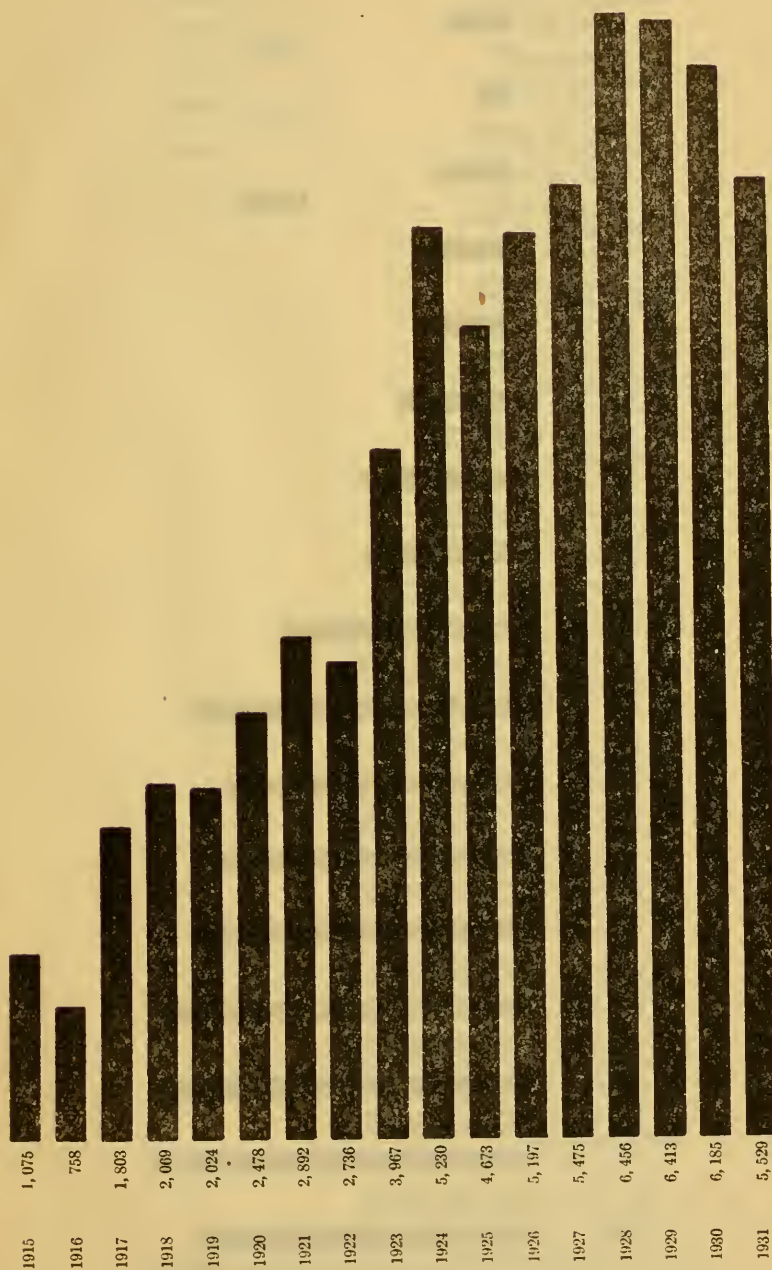
PLATE 17





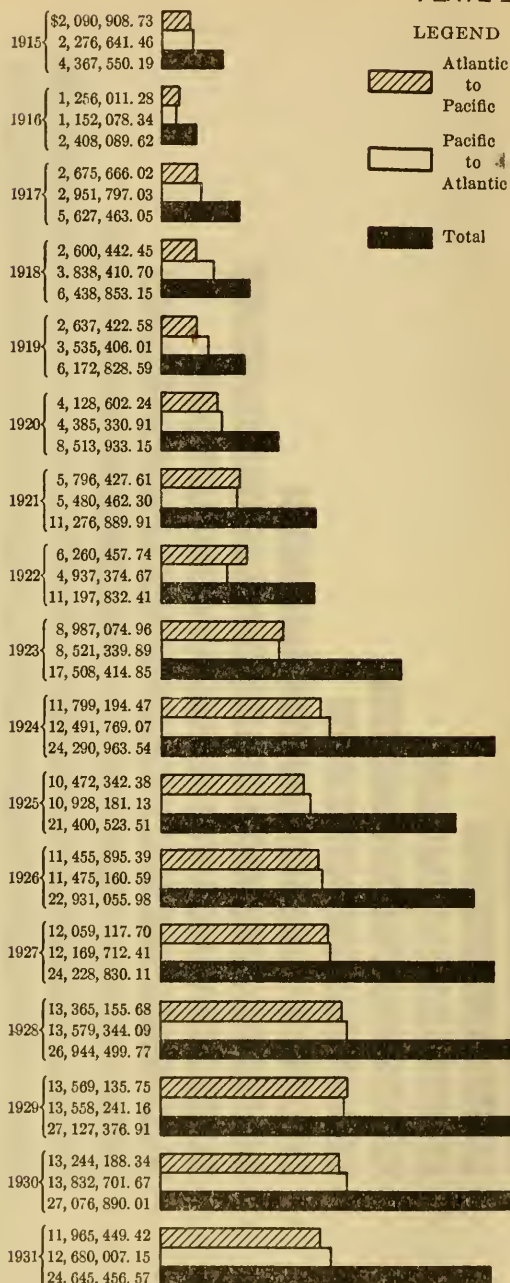


GRAPH OF PERCENTAGE OF NET TONNAGE, PANAMA CANAL MEASUREMENT, OF SHIPS OF UNITED STATES AND FOREIGN REGISTRY, BY FISCAL YEARS. (THIS GRAPH ALSO INDICATES APPROXIMATELY THE PROPORTION OF TOLLS PAID BY UNITED STATES AND FOREIGN VESSELS)



GRAPH OF NUMBER OF COMMERCIAL VESSELS TRANSITING THE PANAMA CANAL, BY FISCAL YEARS

PLATE 21



GRAPH SHOWING TOLLS COLLECTED BY FISCAL YEARS SINCE OPENING OF CANAL

UNIVERSITY OF FLORIDA



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